

A wide-angle photograph of a natural landscape. In the foreground, a river with many small, shallow tributaries winds its way through a valley. The valley floor is covered in dry, golden-brown grass. In the background, there are rolling hills and mountains, also with some vegetation. The sky is a clear, pale blue.

Seminar of country presentations and discussion (MONGOLIA)

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Department of Biology, School of Arts and Sciences,
National University of Mongolia

16/09/2012 08:31

Content

- Overview of Mongolia
- Hydrobiological Survey Valley of the Great Lakes
- Geomorphology of transboundary Bulgan River

Fragile systems

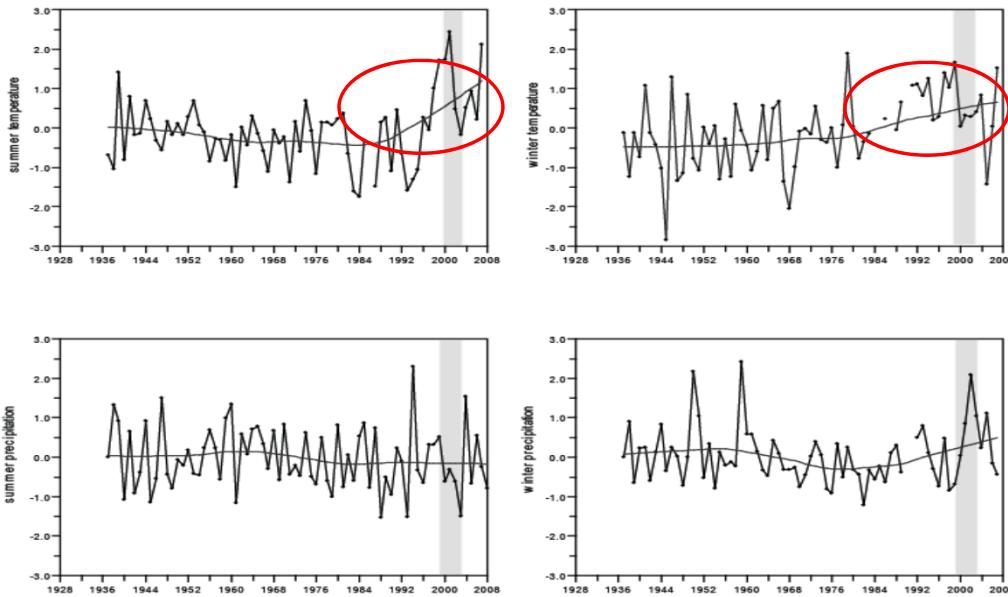


Territory	1,564,118 km ²
Population	3.1 Mio
Growth rate	1.25 %
Life expectancy	65-74
GDP growth	< 10%
Literacy	98%

About 6.4 times smaller than China and two times smaller than India

Fragile systems

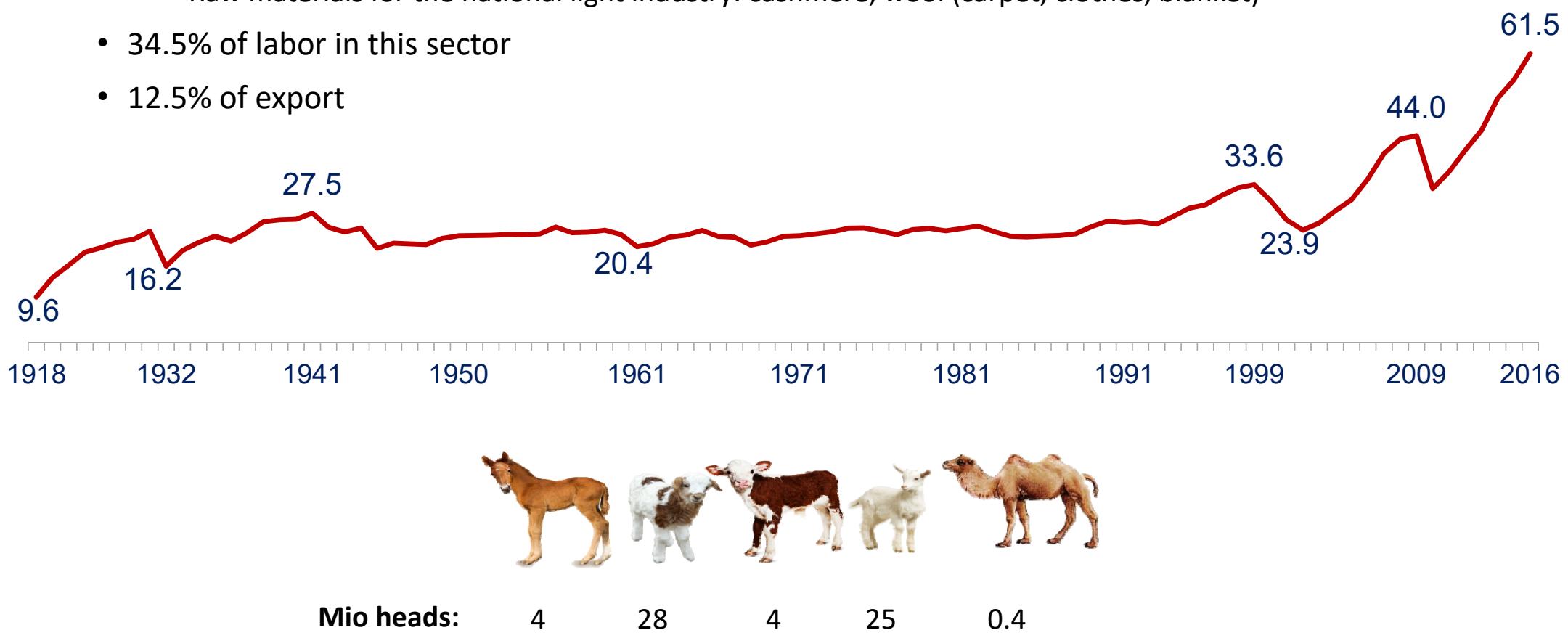
- Continental climate
 - Summer mean temperature
 - Winter mean temperature
- Limited precipitation
 - 50 mm in the Gobi Desert
 - Up to 450 in the high mountains
- Sharp 4 seasons



Bulgan River, May 2007

Agricultural significance and herd composition

- 14% of GDP (40% in the mid 1990s)
 - Food
 - Raw materials for the national light industry: cashmere, wool (carpet, clothes, blanket)
- 34.5% of labor in this sector
- 12.5% of export



Pasture

- 70% of the territory covering mountain, steppe and Gobi Desert
 - 1% of the pasture is hay field
- decreased by 7% since 1964 due to climate and land use change (MFALI)
 - there is a tendency of vegetation biomass degradation,
 - loss of plant species partly – animal numbers, goats,
- Mountain-steppe is vulnerable than steppe and desert-steppe (Khishigbayar et al., 2015)

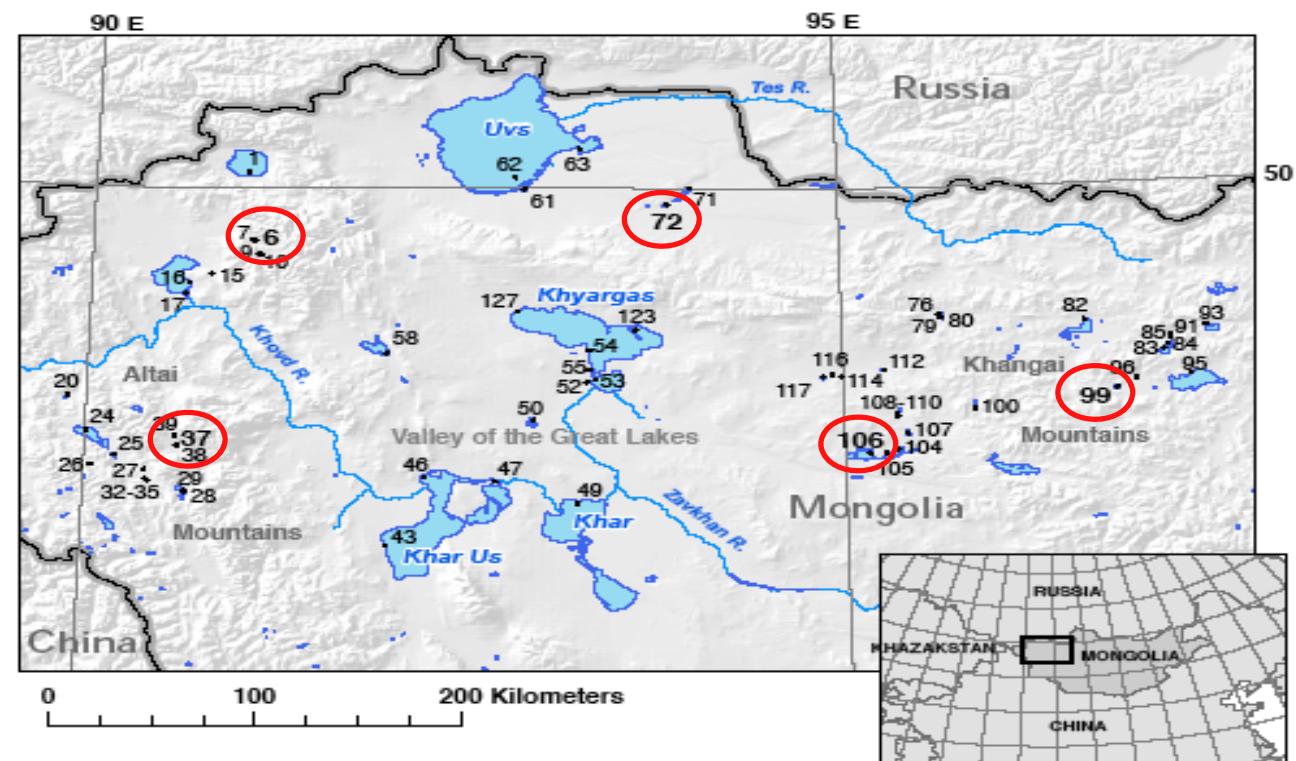


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Hydrobiological Survey Valley of the Great Lakes

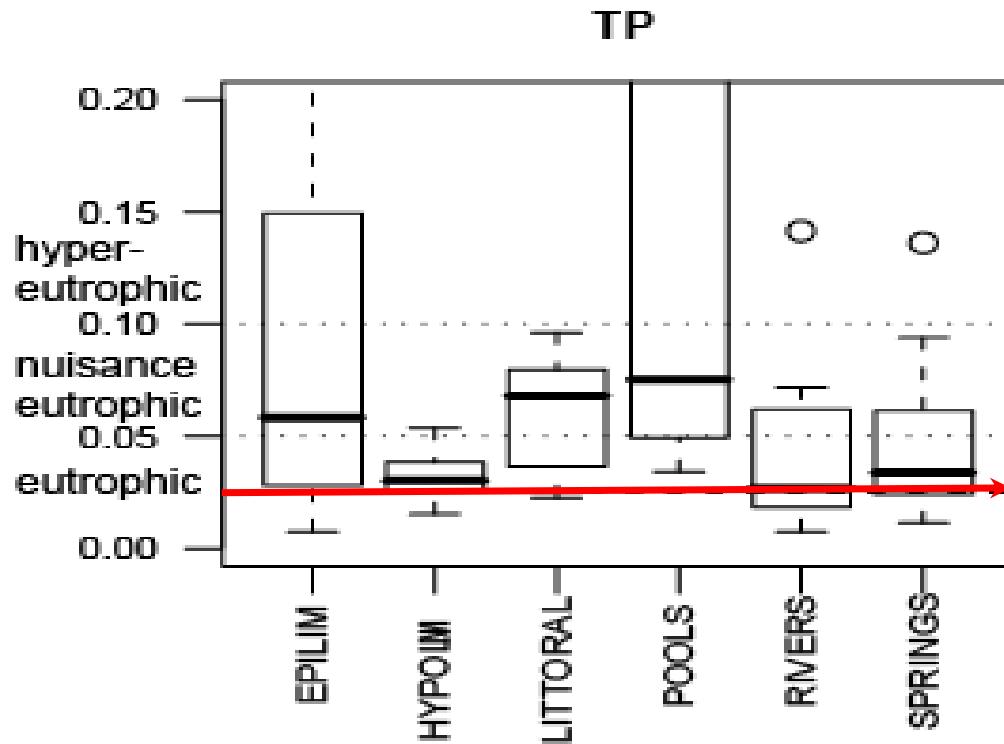
- Biodiversity of ostracodes, diatoms, and chironomids
- Modern water chemistry and association with biological communities, streams, springs, 60+ lakes
- Identification of indicator species, calibration sets
- Collection of sediment cores for paleo-limnological work



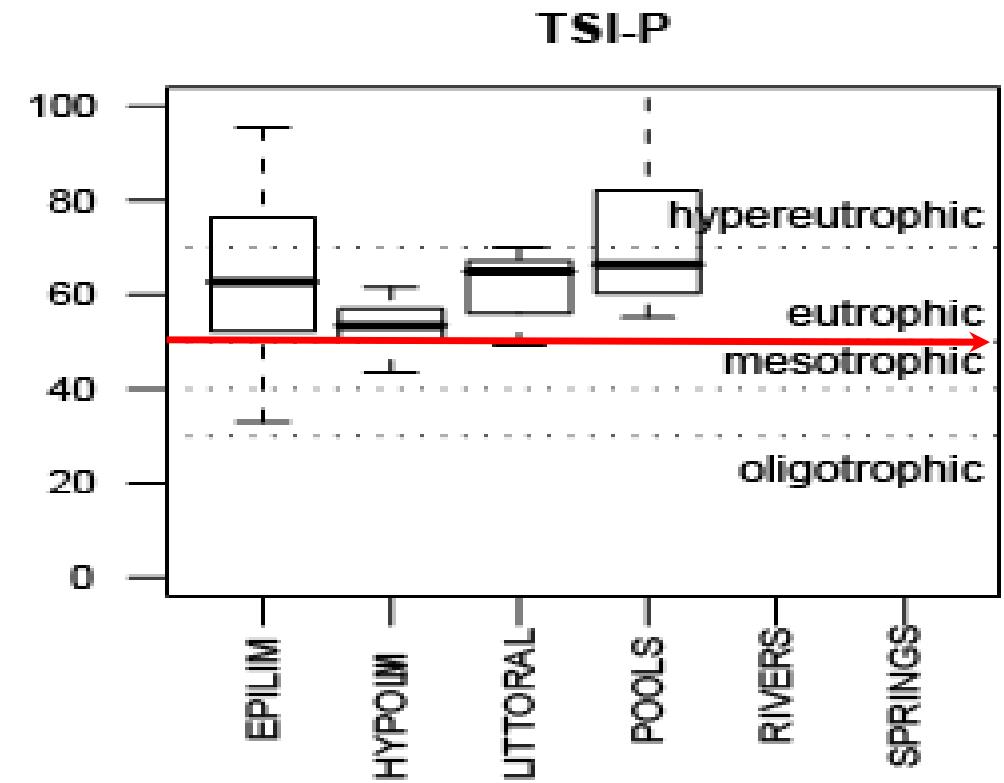


Water quality

Total Phosphorus



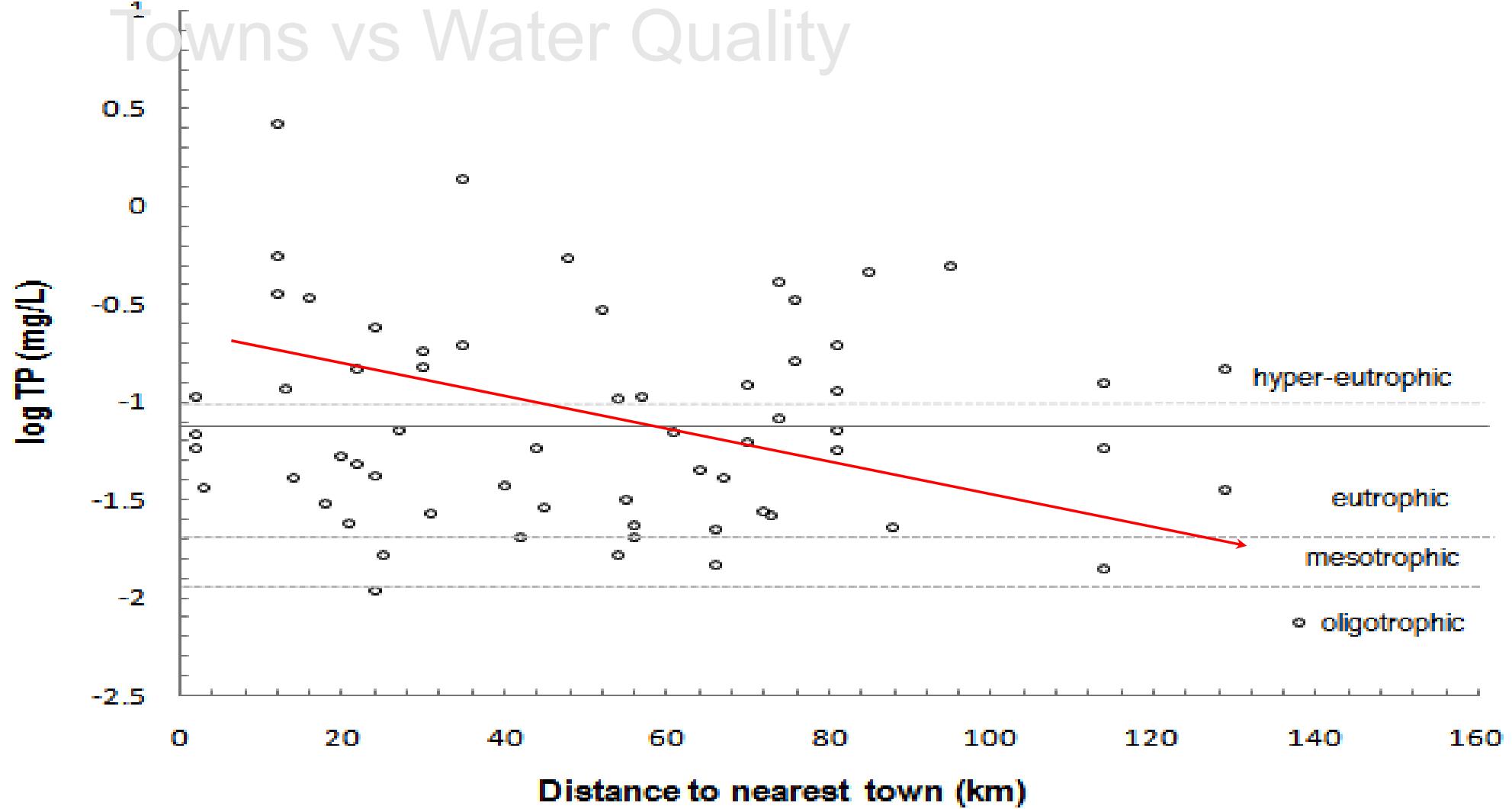
Trophic State Index



Water quality is poor in western Mongolia!
(US EPA standard)



Towns vs Water Quality



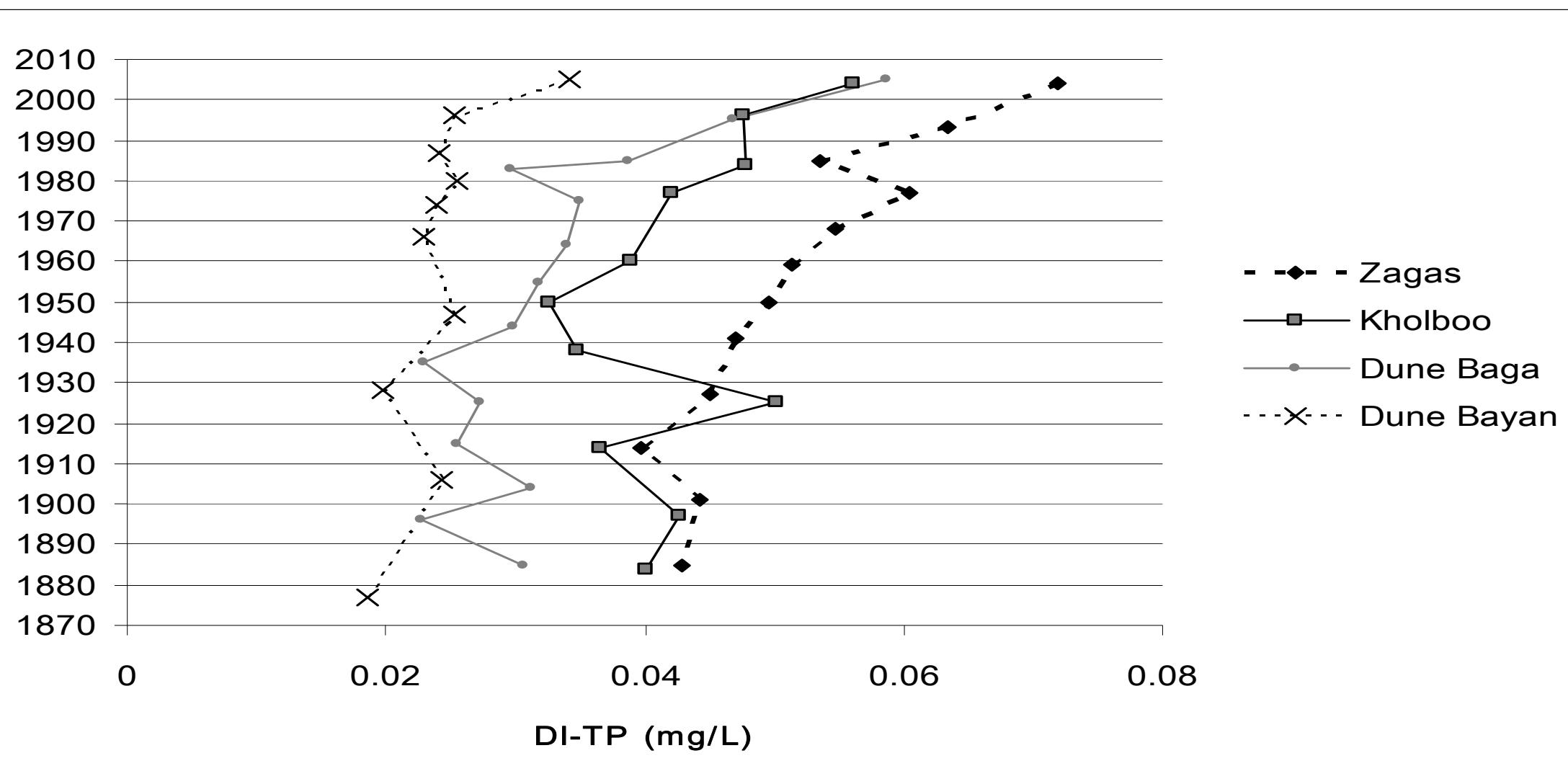
Research Question - Have the Mongolian lakes always been eutrophic or is this a recent phenomenon?

Sediment core reconstructions

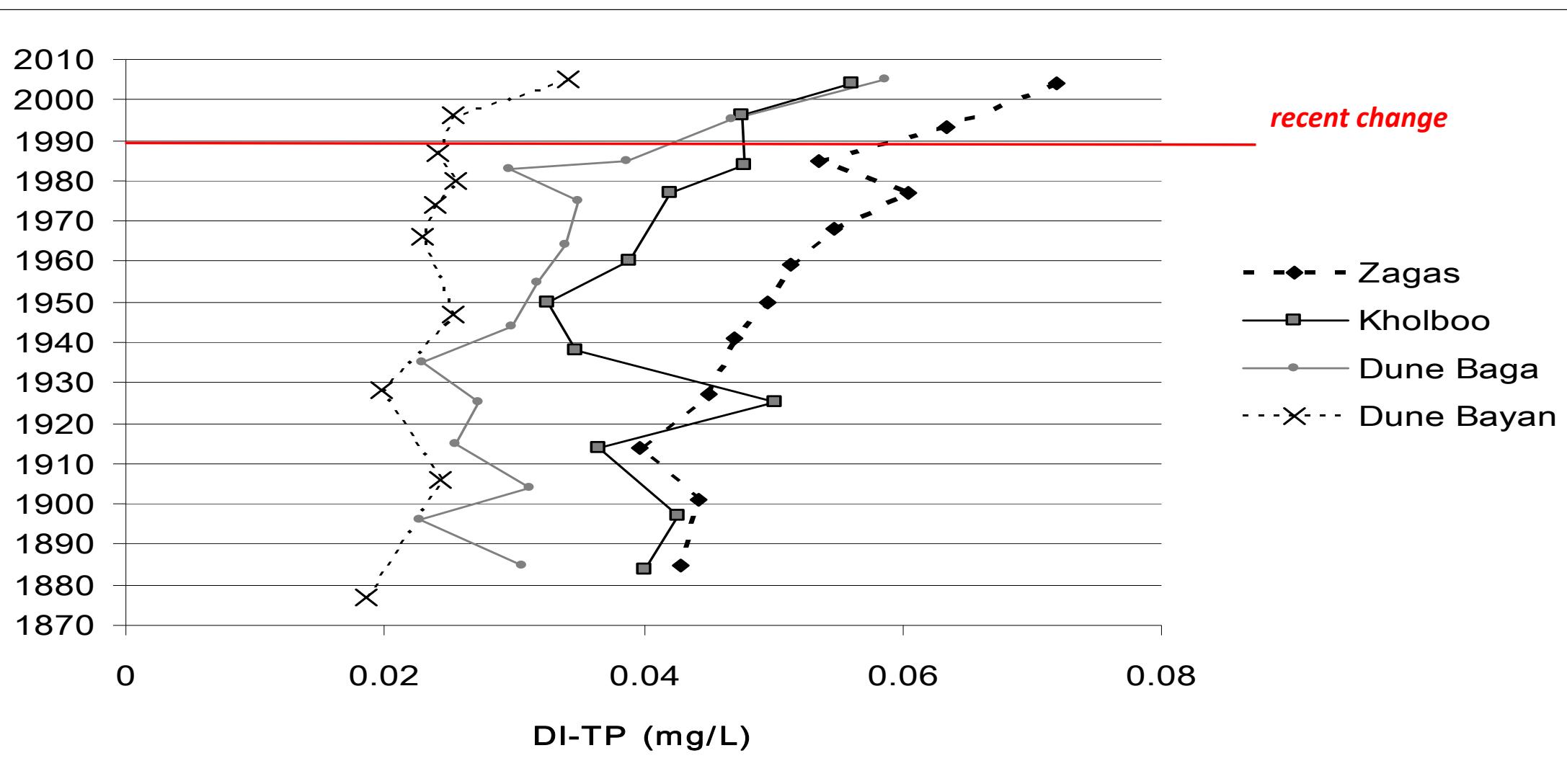
- 5 sediment cores; dated with ^{210}Pb
- Lakes span the east-west and elevational range of the region
- Expected to see no change in TP over last 100 years or changes correlated to known land use shifts



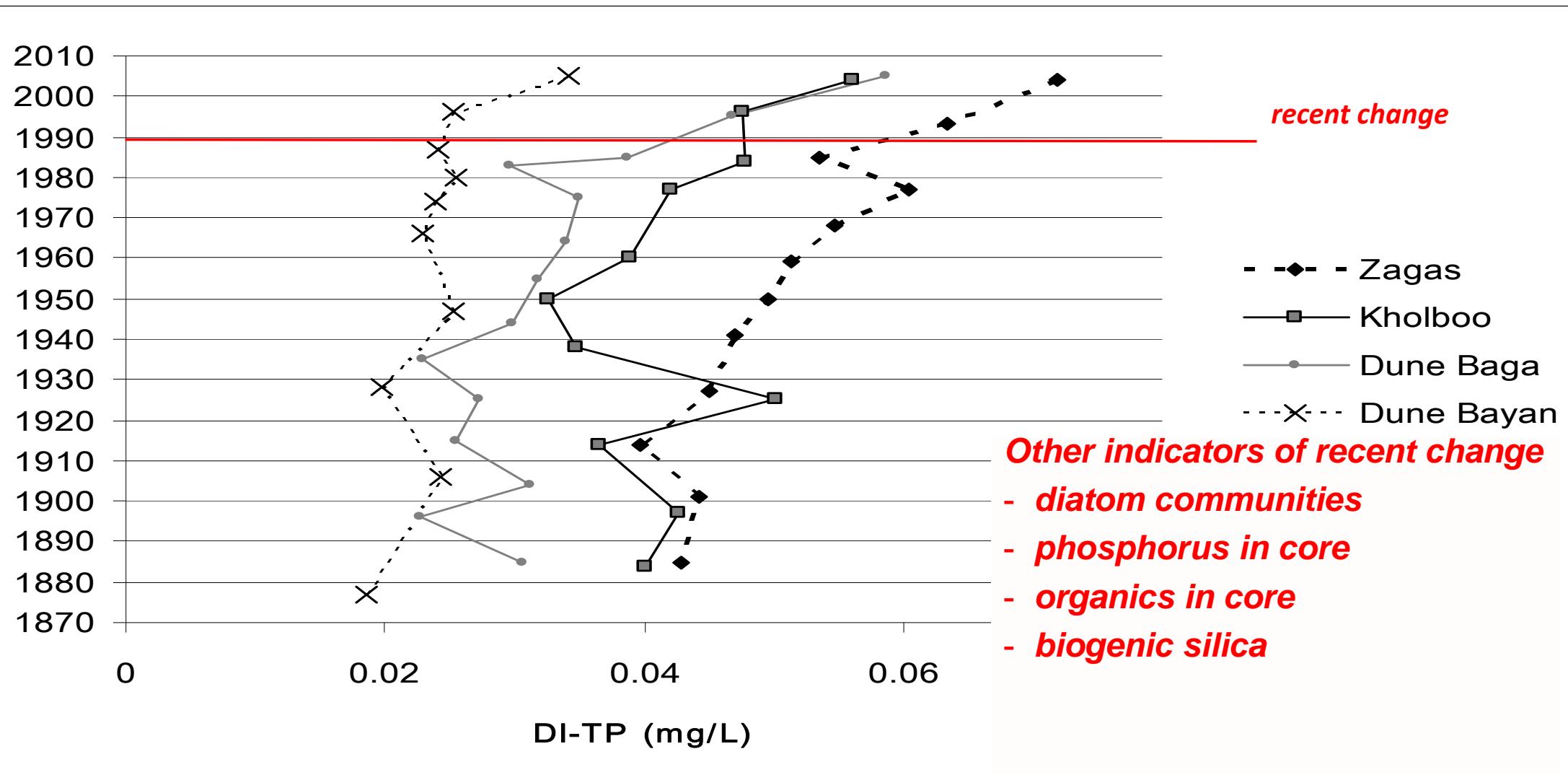
Core reconstructions - diatom-TP



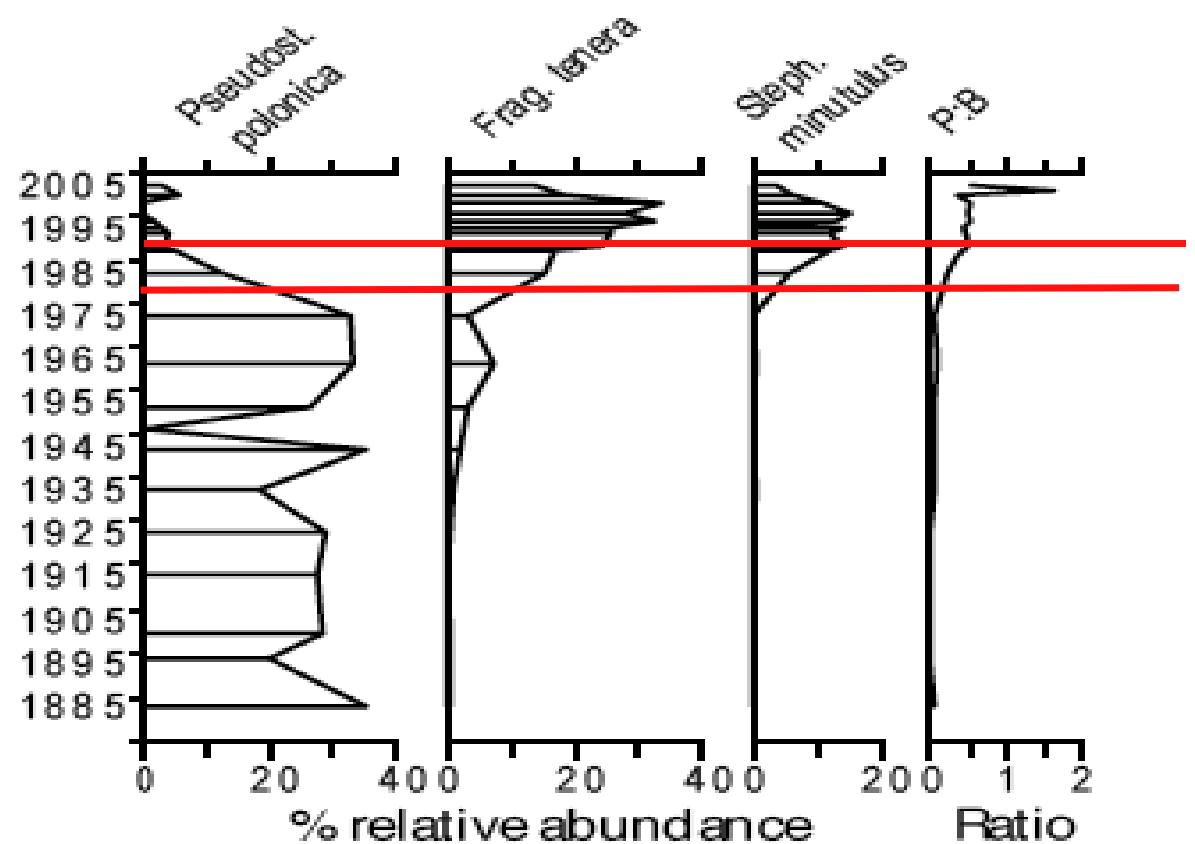
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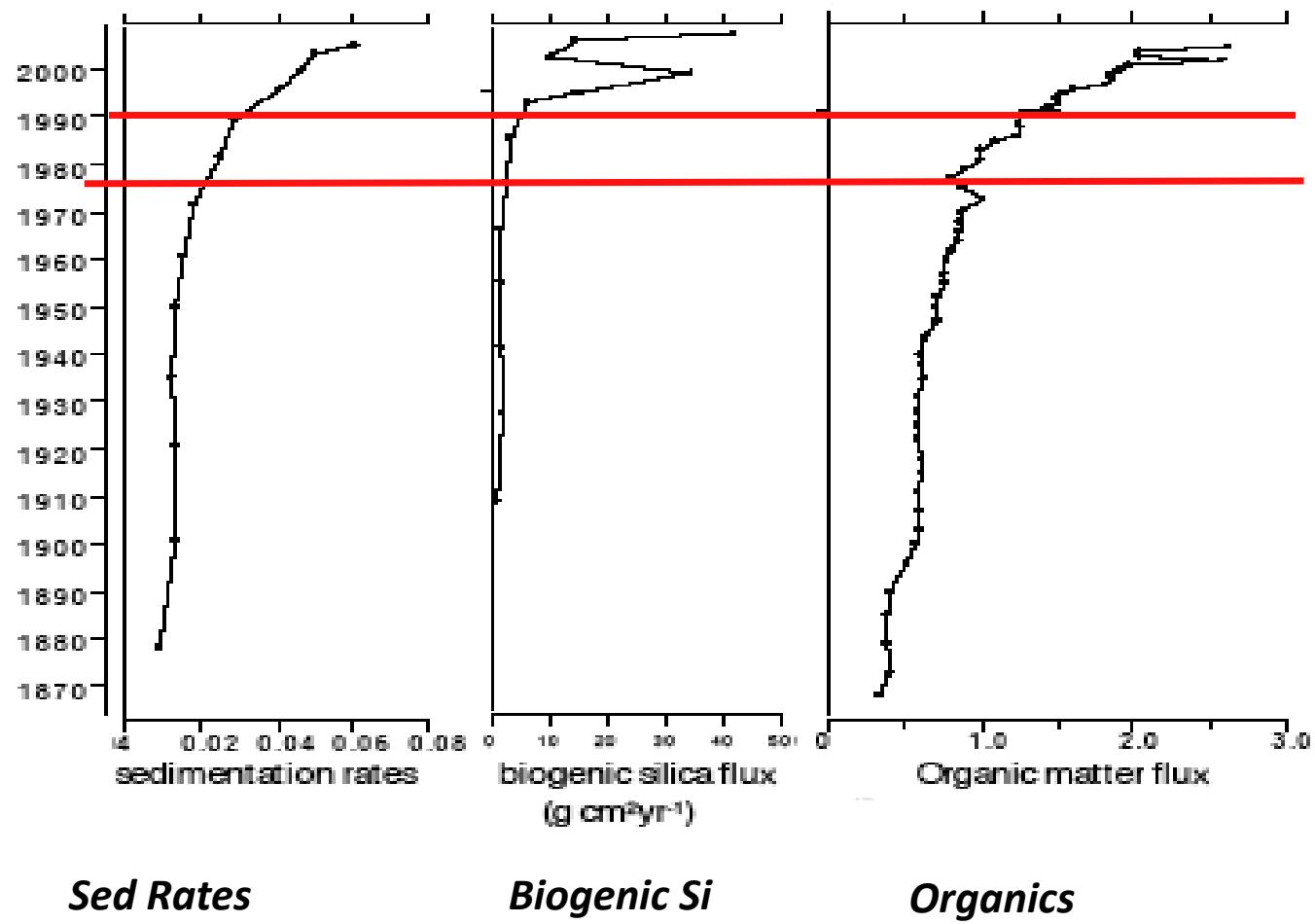
Core reconstructions - diatom-TP



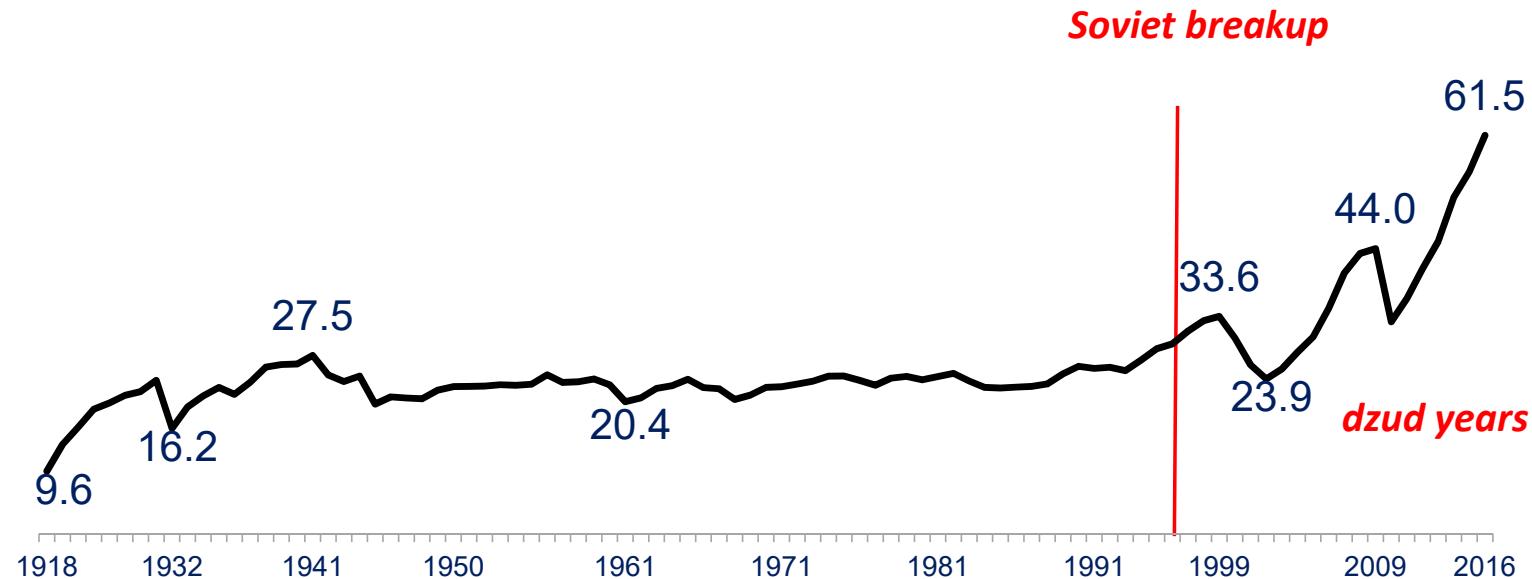
Diatom response - Baga Nuur



Sedimentation & Biogeochemistry - Baga Nuur



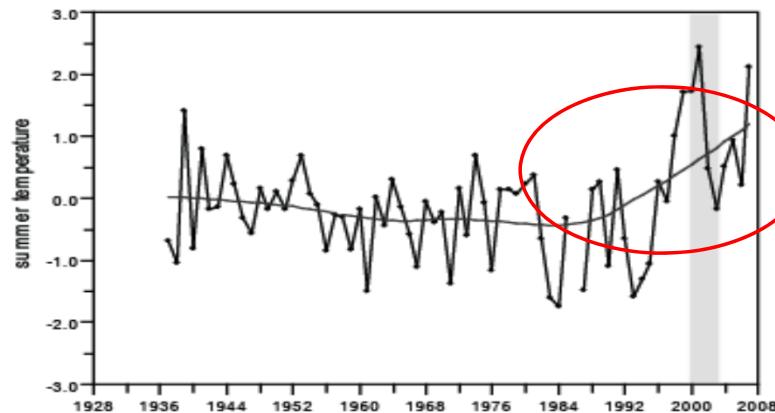
Why? - Livestock/Grazing Pressure?



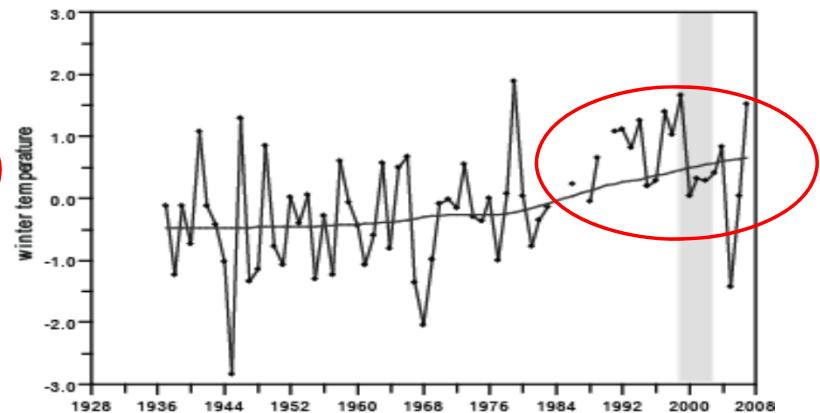
Water quality is poor in western Mongolia!

Climate Change

Temp

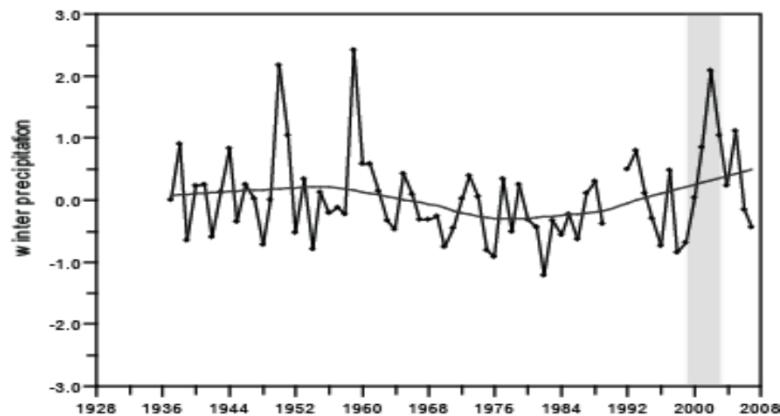
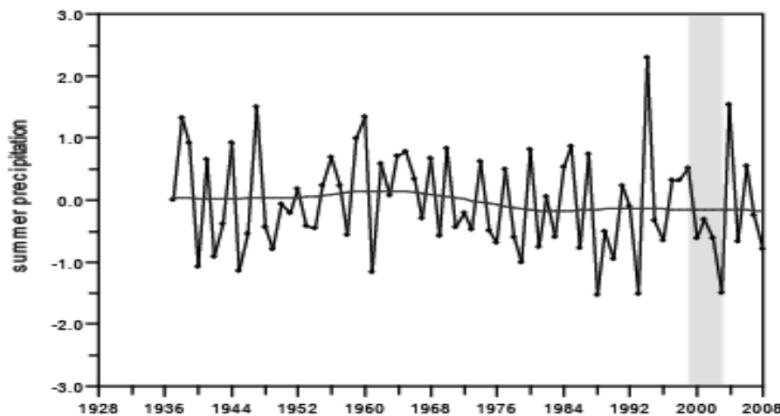


Summer



Winter

Precip



Climate is changing rapidly in western Mongolia!

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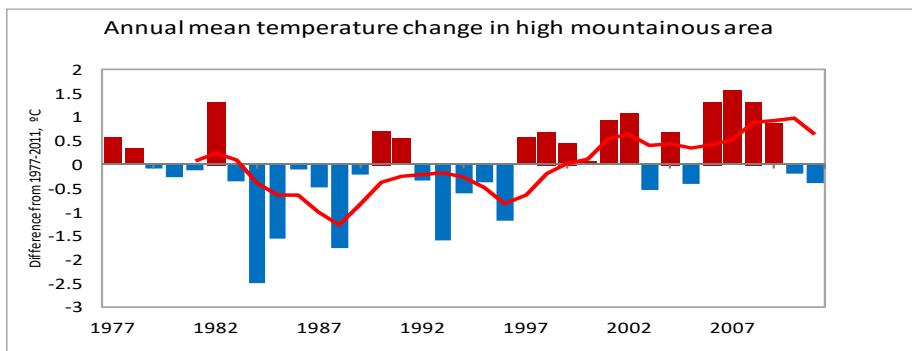
Bulgan River



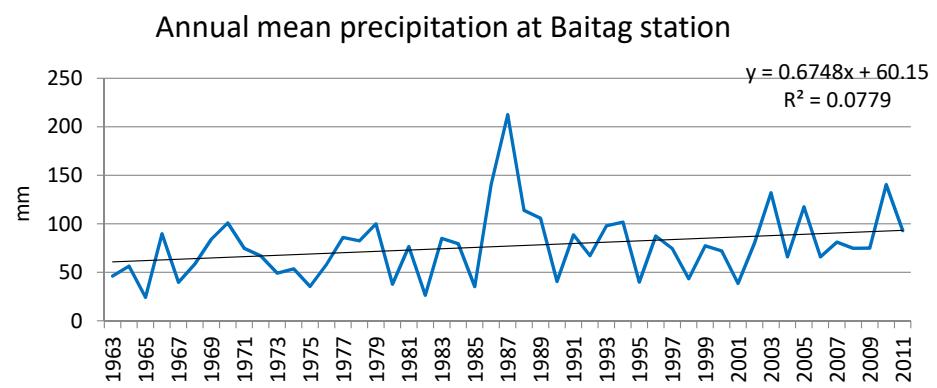
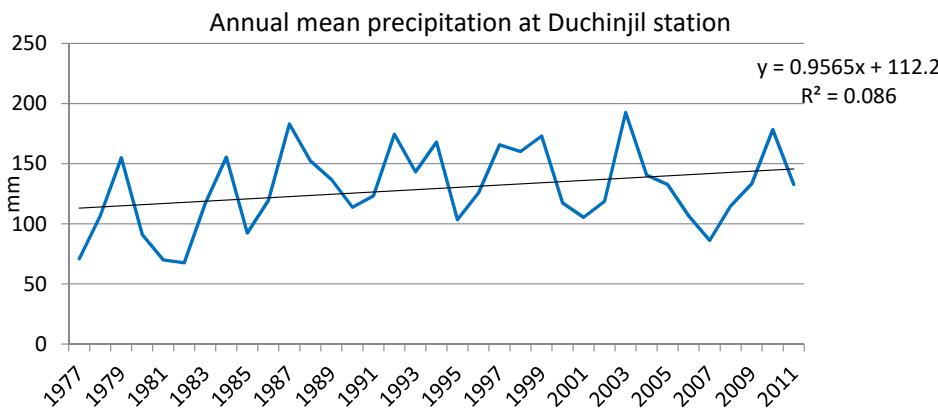
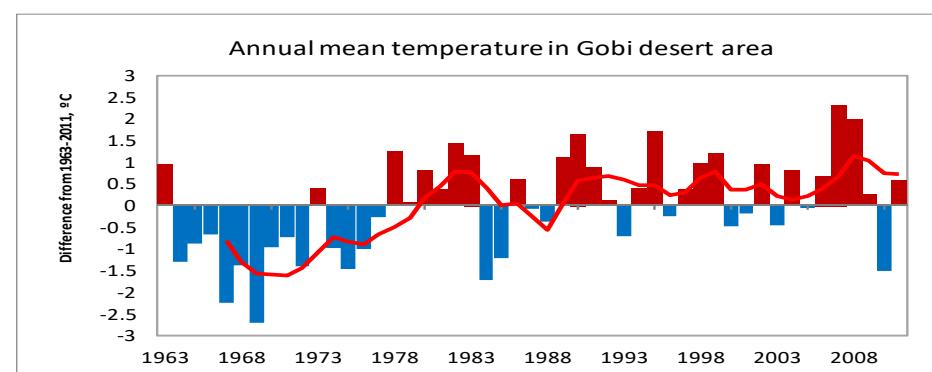
- The river and adjacent wetland need adequate water to sustain ecological process and associated goods and services.
- Streamflow quantity and timing are critical factors determining the ecological integrity of river systems.
- Bulgan River has no large human impact.

Climate variability and change in Bulgan watershed

Duchinjil station, 1951 m



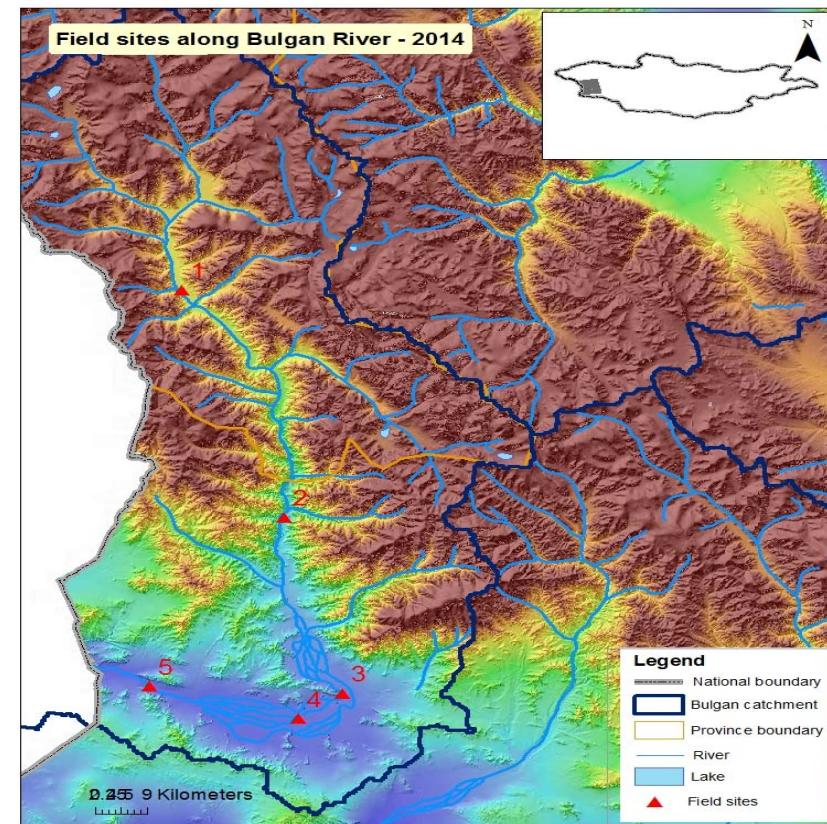
Baitag station, 1181 m



Goal and objectives

- Assess environmental flow required aquatic and riparian ecosystem by characterizing the watershed
 - Quantitative Physical Habitat Characterization to describe spatial variability
 - Geomorphologic classification of each sites
 - Diatoms
 - Benthic Macroinvertebrates
 - Bankfull flow analysis as a minimum environmental flow

Site selection



Habitat Sampling Locations

Reach Length 40 times wetted width
 Transect Spacing 1/10 Reach length

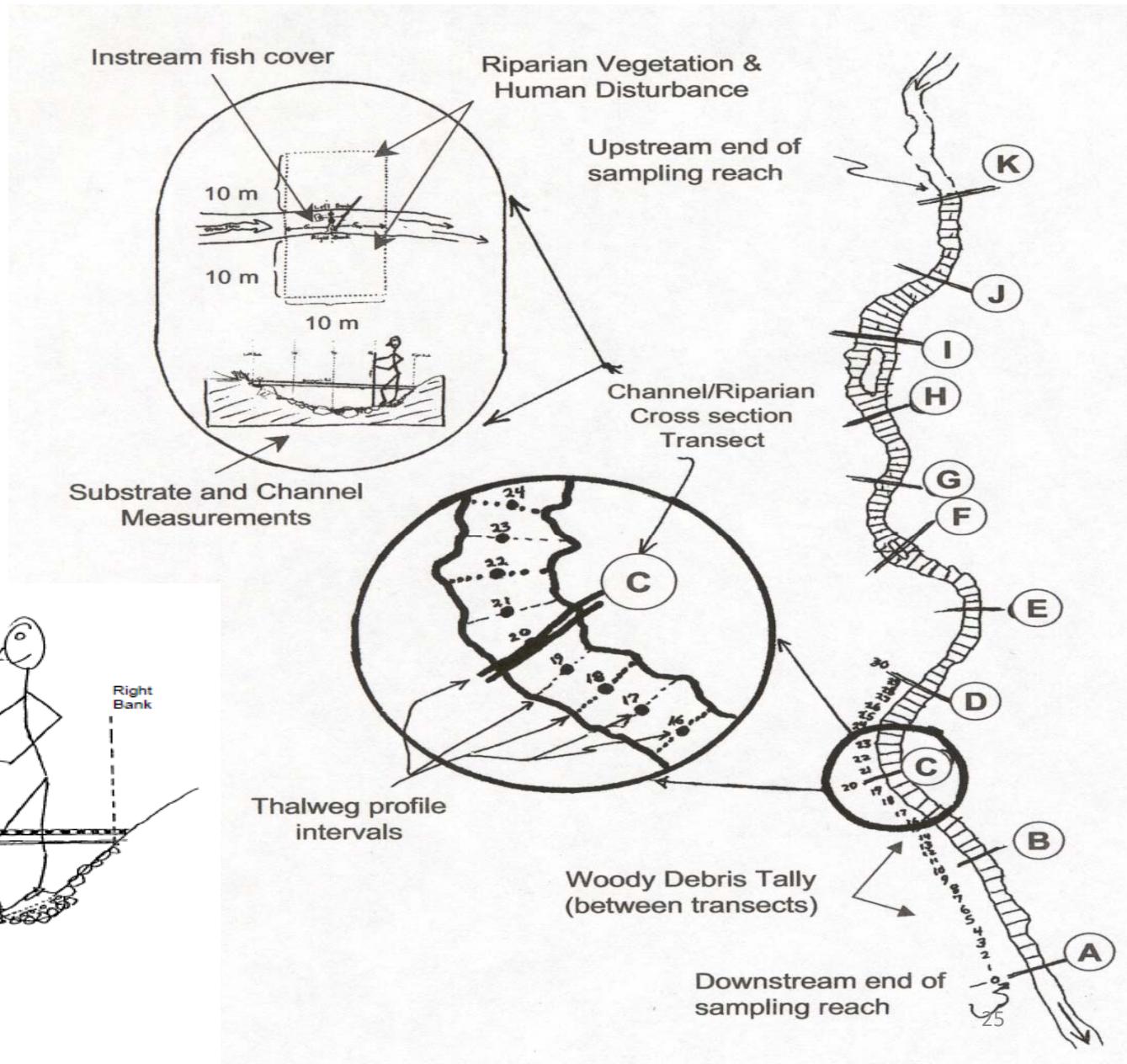
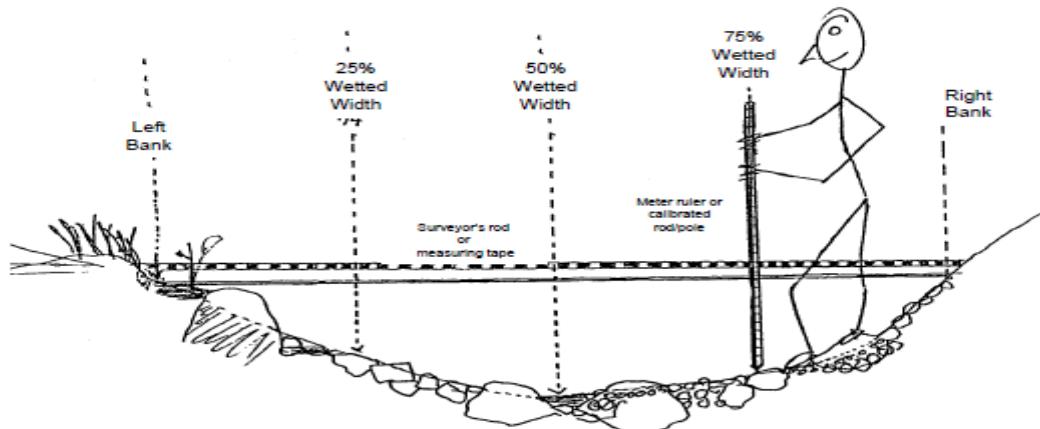
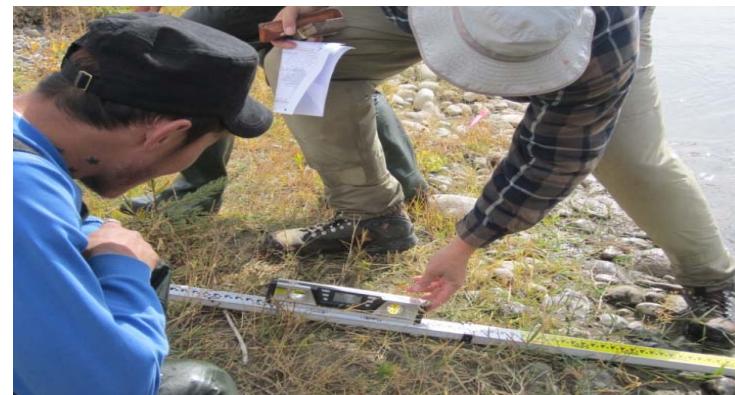


Figure 7-6. Substrate sampling cross-section.



Quantitative Physical Habitat Characterization

- Physical attributes sustain organisms in a river
- Natural and human disturbance
- Seven general physical habitat attributes influencing river ecology
 - Channel dimension
 - Channel gradient
 - Channel substrate size and type
 - Habitat complexity and cover
 - Riparian vegetation cover and structure
 - Anthropogenic alteration
 - Channel riparian interaction

Source: Scott Kenner

Metadata

STREAM VERIFICATION FORM - STREAMS/RIVERS (cont.)

Reviewed by (Initials): _____

SITE NAME:	Bulgan sum centre	DATE:	01/10/2003	VISIT: 0	<input checked="" type="radio"/> 1 <input type="radio"/> 2 <input type="radio"/> 3
SITE ID:	BLN05	TEAM:	3		
STREAM/RIVER REACH DETERMINATION					
Channel Width Used to Define Reach (m)	DISTANCE (m) FROM X-SITE	DETERMINATION OF Reach	Length Intended (m)	Comment	
3.0	Upstream Length 6.00	Downstream Length 6.00	Length Intended (m) 12.00		
SKETCH MAP - Arrow Indicates North					

PERSONNEL

NAME	Biomorph	DUTIES Geomorph	Forms
Team 1: Thalhee; Tuguldur, Sudarch	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Team 2: Cross-section: Nyamtulga, Ulsii	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Team 3: Tuwshinbayar, Narangerav	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
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56029

04/03/2002 2002 Stream Verification

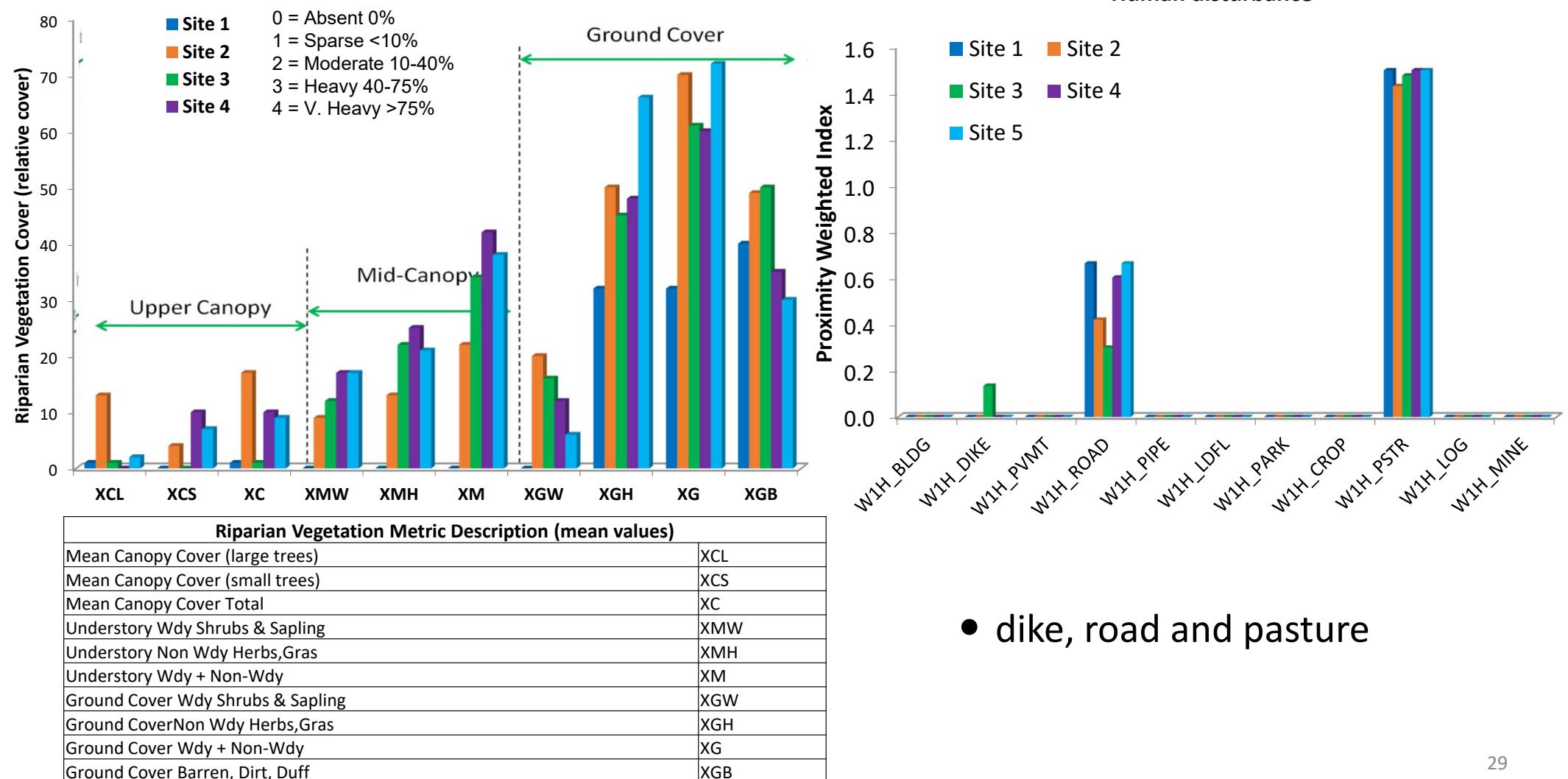
PHab: CHANNEL/RIPARIAN CROSS-SECTION FORM - STREAMS

Reviewed by (Initials): _____

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Reviewed by (Initials): _____																																						
SUBSTRATE CROSS-SECTIONAL INFORMATION <table border="1"> <thead> <tr> <th>Dist LB XXXX m</th> <th>Depth XXX cm</th> <th>Size Class Code</th> <th>Embed. 0-100%</th> <th>Flag</th> </tr> </thead> <tbody> <tr> <td>Left 1m</td> <td>43</td> <td>-</td> <td>100</td> <td></td> </tr> <tr> <td>Lctr 4.5</td> <td>16</td> <td>-</td> <td>30</td> <td></td> </tr> <tr> <td>Ctr 9</td> <td>46</td> <td>-</td> <td>70</td> <td></td> </tr> <tr> <td>RCtr 13.5</td> <td>40</td> <td>-</td> <td>85</td> <td></td> </tr> <tr> <td>Right 19</td> <td>18</td> <td>-</td> <td>95</td> <td></td> </tr> </tbody> </table>			Dist LB XXXX m	Depth XXX cm	Size Class Code	Embed. 0-100%	Flag	Left 1m	43	-	100		Lctr 4.5	16	-	30		Ctr 9	46	-	70		RCtr 13.5	40	-	85		Right 19	18	-	95							
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Vegetation cover, structure and human disturbance



- dike, road and pasture

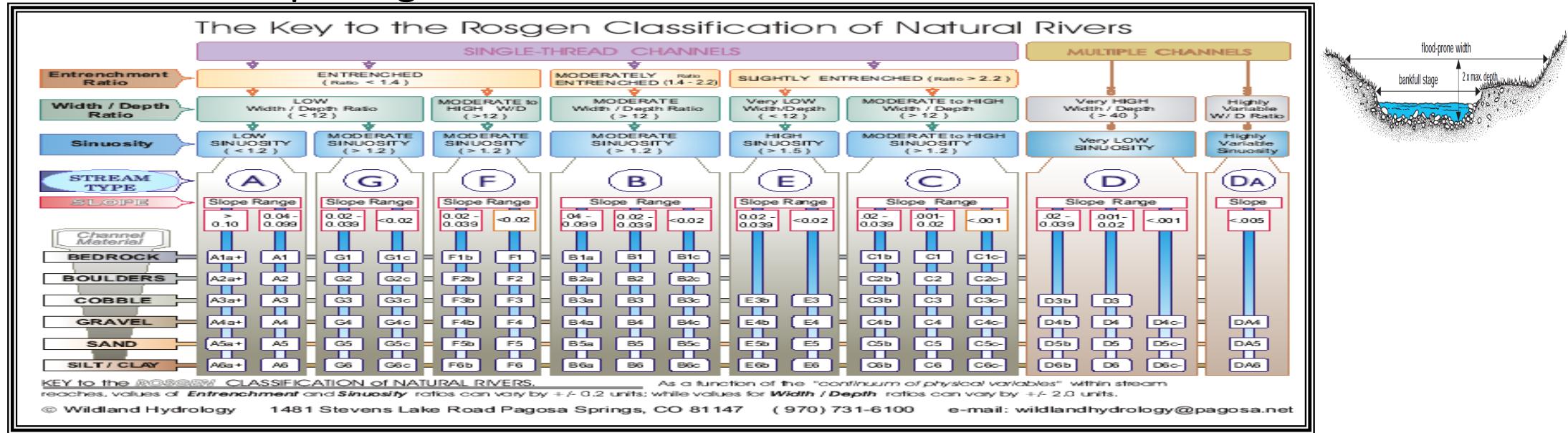
Riparian vegetation: Dominant species changes from river bank to plain

(Source from Oyundari, 2014)



- Bulgan (Bayan-Ulgii) -1936m
 - Carex 77% (0.9m), Achnatherum 20% (11.7m) on left bank
 - Carex 92%(0.9m), Potentilla 60% (6m) on right bank
- Shuvter (Bayan-Ulgii) -1801m
 - Carex 35% (0.3m), Equisetum 69% (2.8 m), Halerpestes 63%(4.8) on left bank
 - Carex 76% (0.4m), Salix 79% (5.3 m), Carex 64% (22.8m) on right bank
- Urt hetsuu -1406m
 - Carex 66% (1m), Leymus 48% (3.6m) Achnatherum 80% (10m) on left bank
 - Царгас 40% (0.3m), Achnatherum 25% (5,80m) on right bank
- Bayangol -1323m
 - Carex 60% (10cm), Phragmites 40% (220cm) Achnatherum 82% (10m) on left bank
 - Poa 80% (1m), Carex 43%(6cm), Phagmitta 59% (20m) Achnatherum35% (40m) on right bank
- Bulgan sum (Khovd) -1194m
 - Улалж шиг 40% (0.6m), **Лидэр** 45% (2,8m) **Лидэр** 3% (4.8m) on left bank
 - Salix 15%(0.1m), Phagmitta 45% (25m) Achnatherum 58% on right bank
- Bulgan down -1165m
 - Carex 95% (0m), **Лошго** 50% (2m) leymus 5% (6m) on left bank
 - Carex 98%(0m), Улалж шиг36% (6m) Oxytropis globra 40% (8m), leymus 90% (30m) on right bank

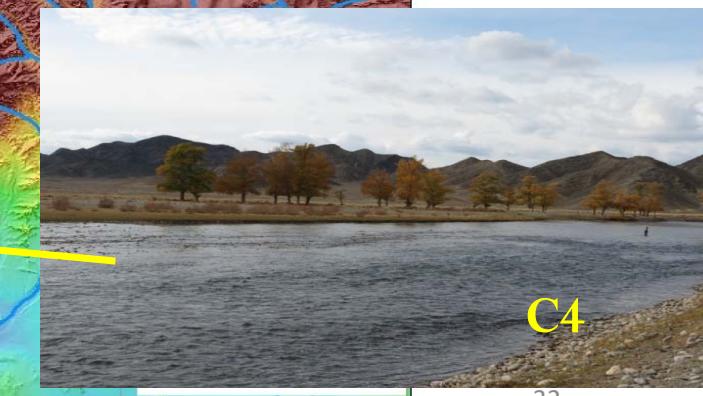
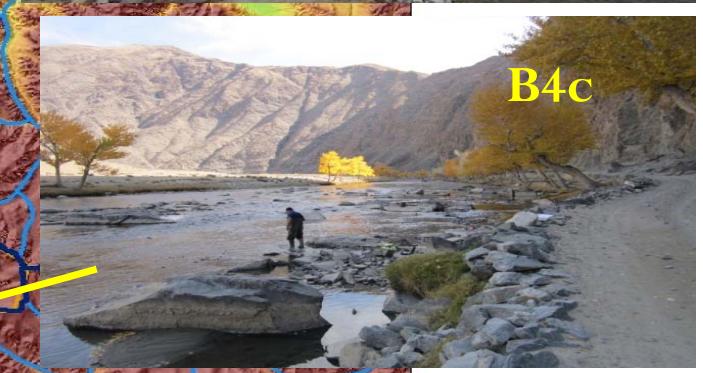
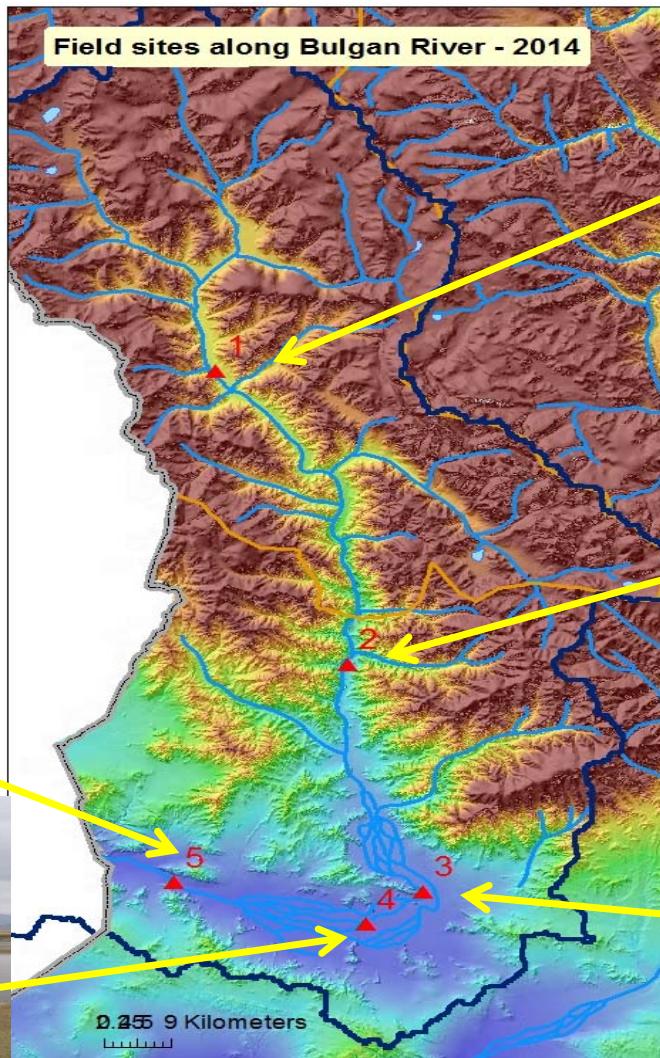
Geomorphologic classification



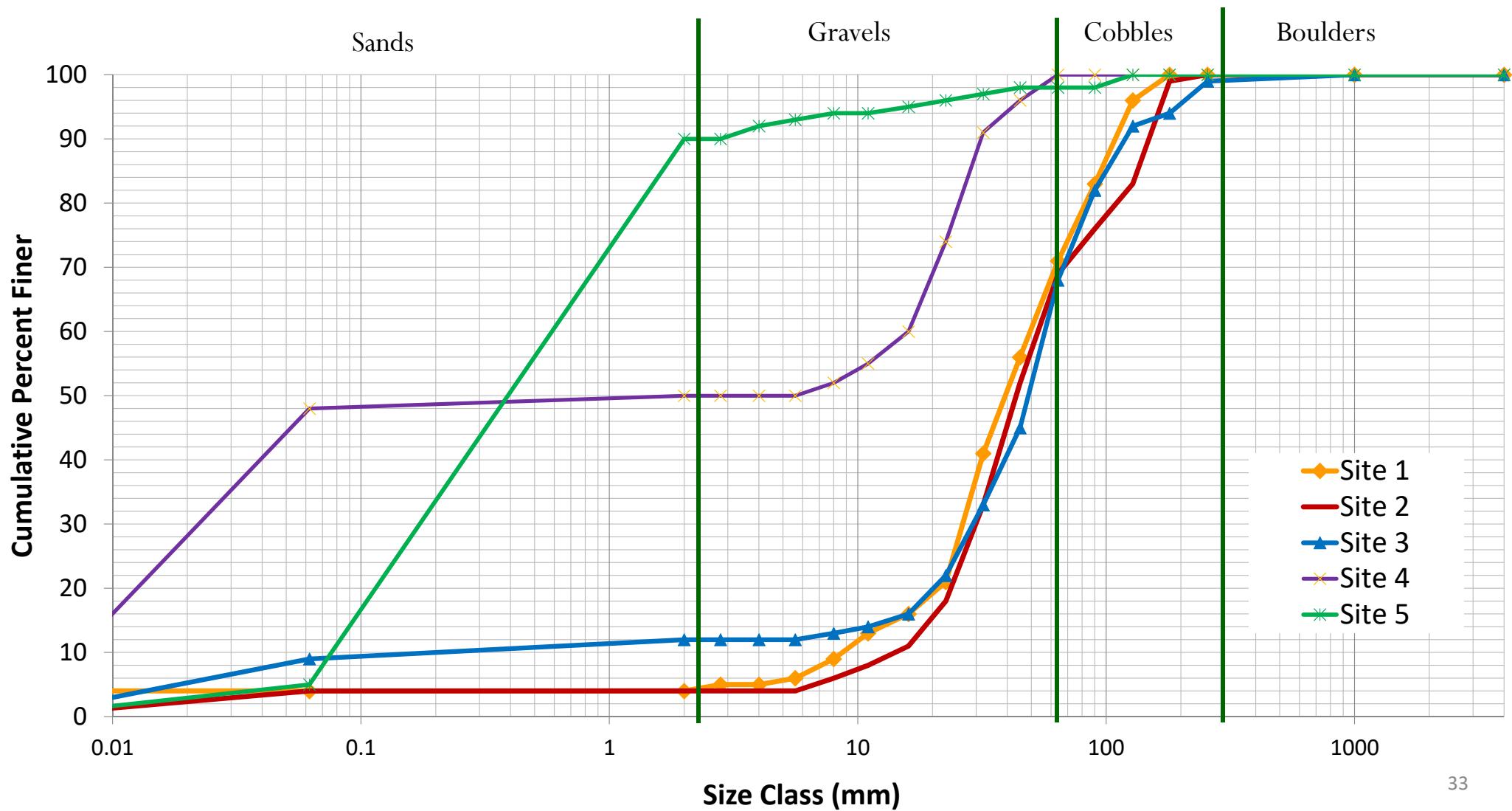
	Site 1	Site 2	Site 3	Site 4	Site 5
Entrenchment ratio	1.21	1.3	1.39	1.36	1.63
Width/Depth ratio	60.2	38.42	15.5	22.9	10.3
Sinuosity	1.12	1.7	1.15	1.53	1.48
Slope	0.005052	0.005749	0.003346	0.000471	0.000608
Channel material	64 (gravel)	64 (gravel)	64 (gravel)	5 (gravel)	2 (sand)
Stream type class	D4	B4c	C4	DA4	G5c

Geomorphologic definition

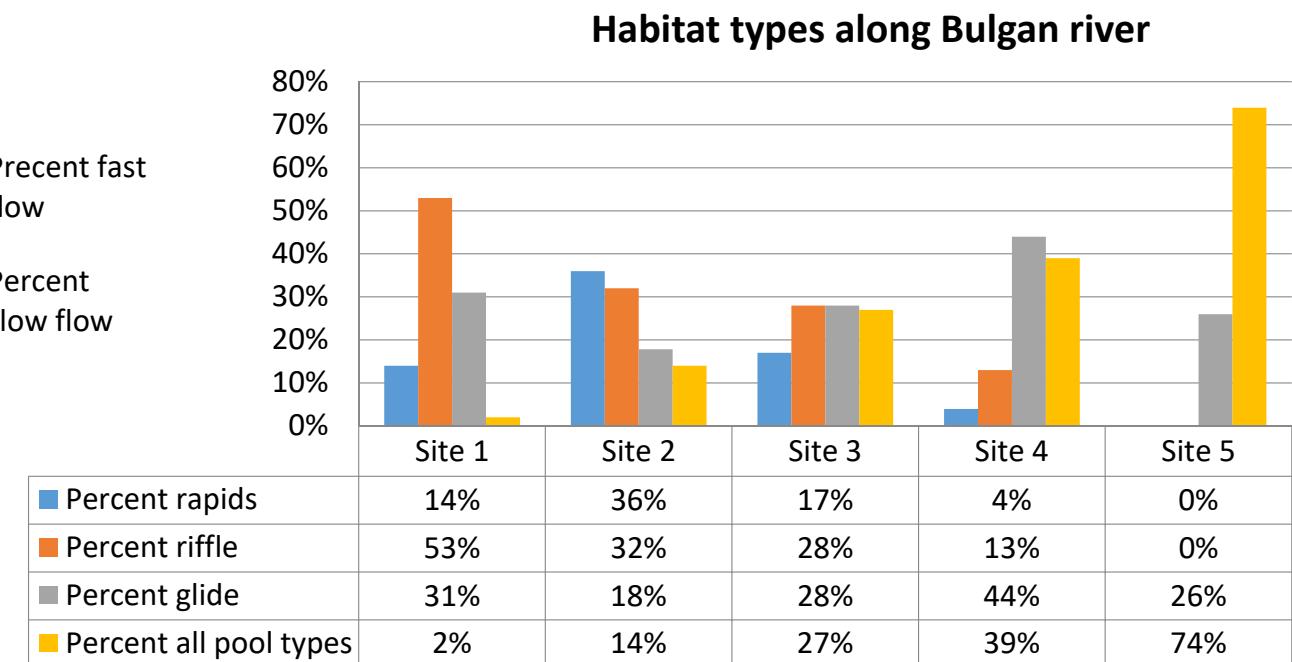
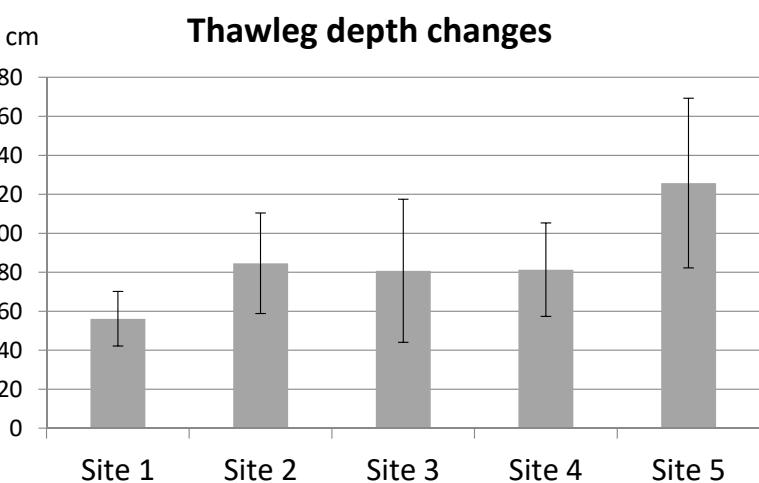
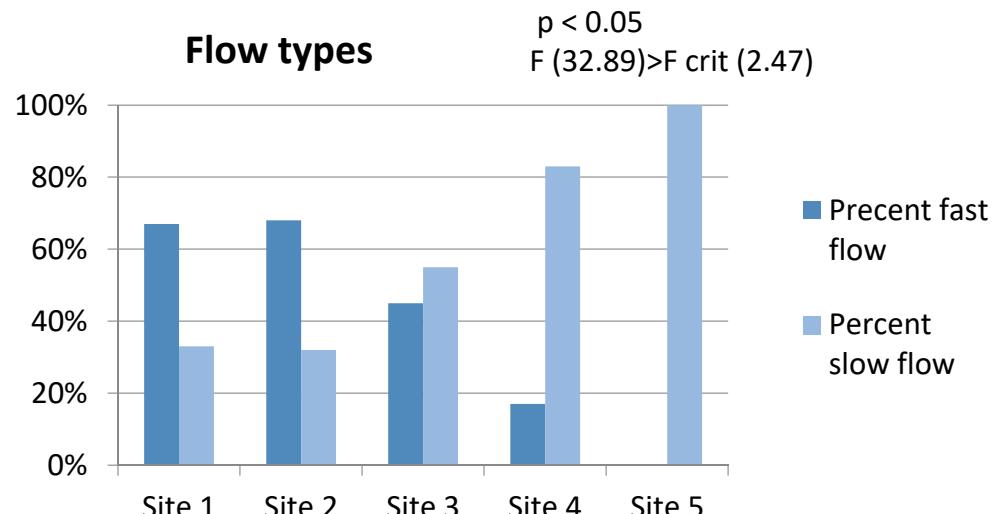
- D4: Glacial outwash valley
- B4c:Narrow valley controlled by gorge and colluvial-alluvial deposits
- C4:Wide, gentle valley with well developed floodplain
- DA4: Broad valley, delta area with multiple channels
- G5c:Broad valley with extensive floodplains and incised narrow and deep stream channel



Plot of pebble count at different sites



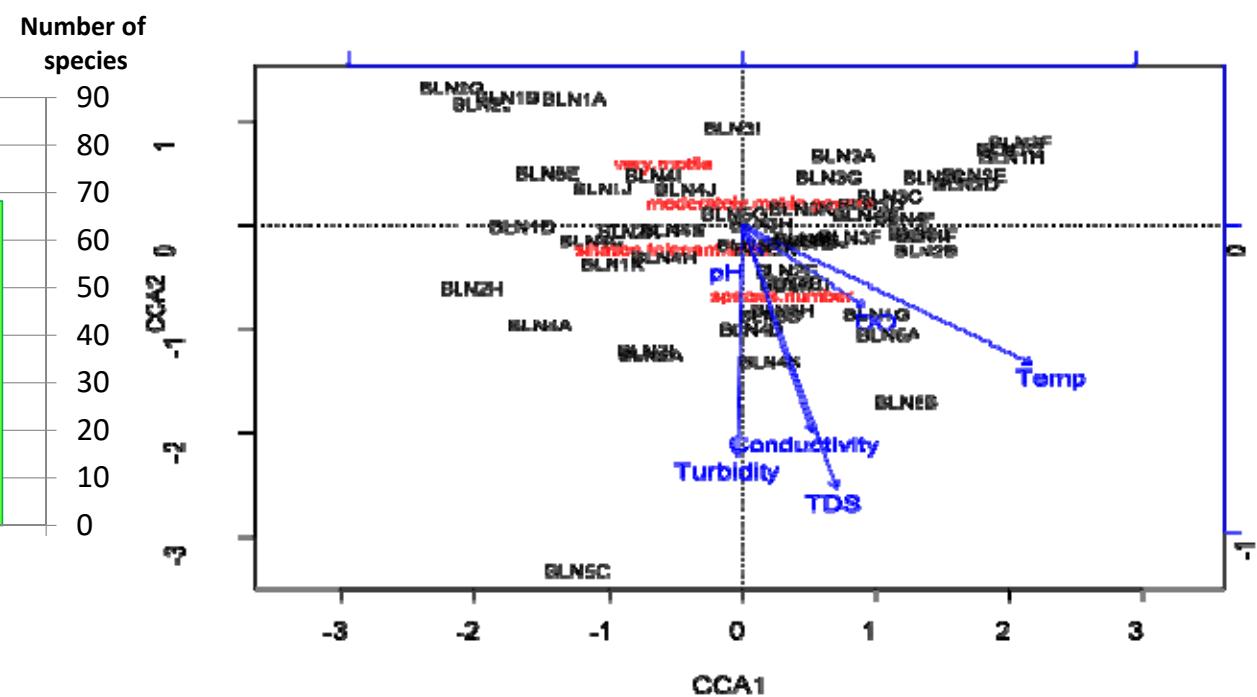
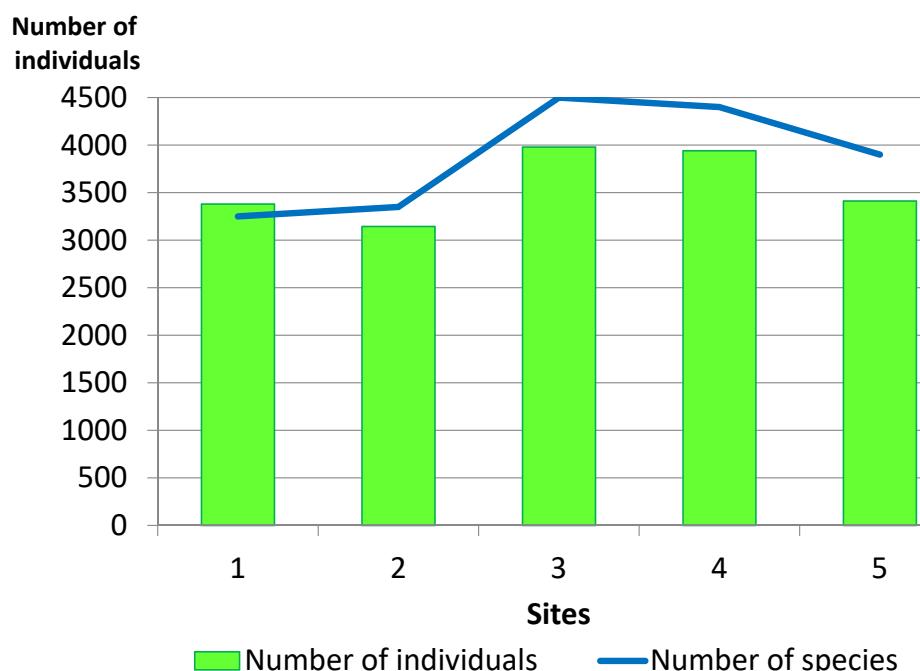
Physical habitat characterization



Thawleg depth - 1 way ANOVA, $p < 0.05$ $F(68.21) > F_{\text{critical}}(2.38)$

Diatom community and water chemistry

48 genera, 140 species total 17857 individuals

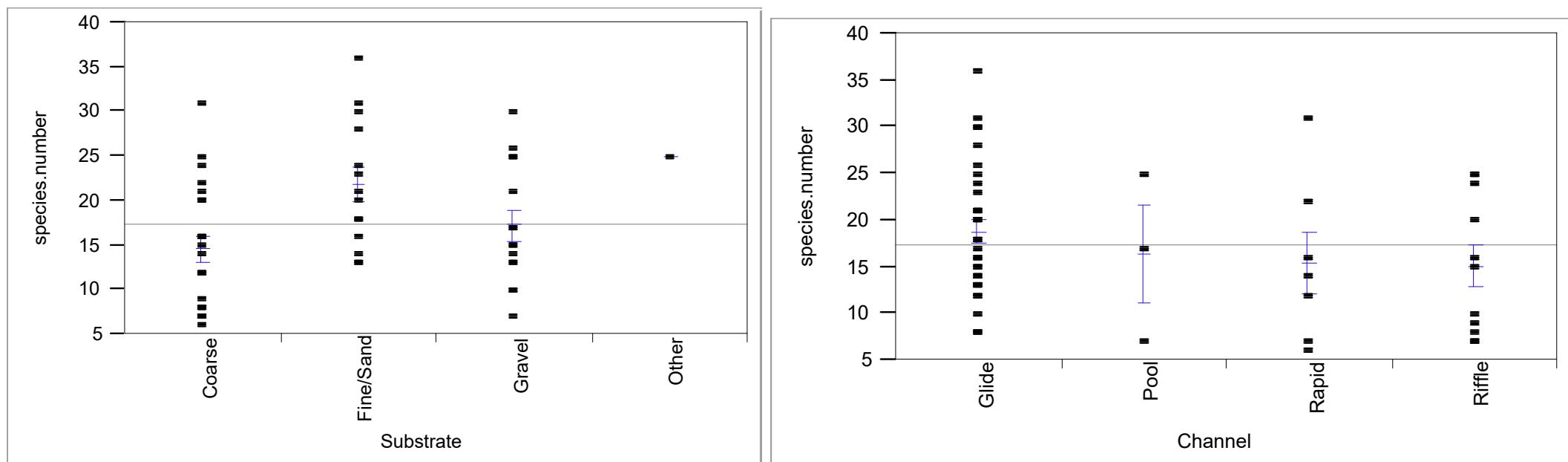


Number of species is different at sites.

ANOVA 1 way $P= 0.000172$ $F(5,7) > F_{critical}(2,4)$

Source: Bukhchuluun, 2015

Oneway Analysis of diatom species.number by substrate and channel

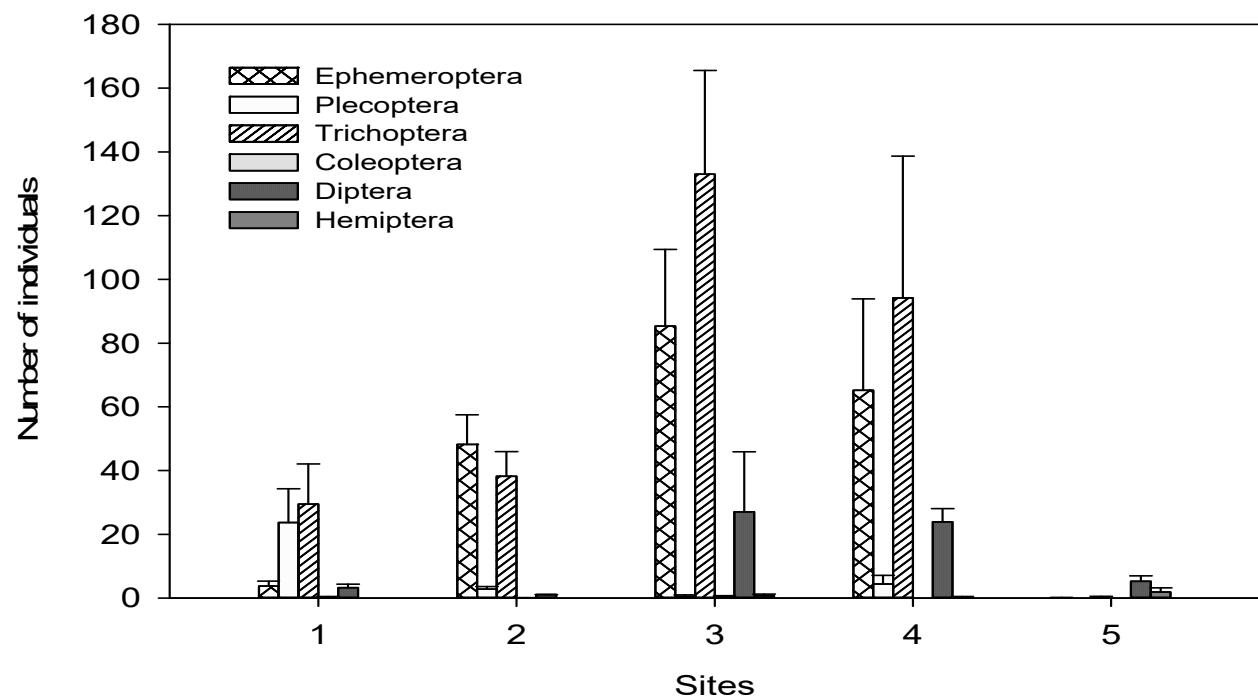


Source: Bukhchuluun, 2015

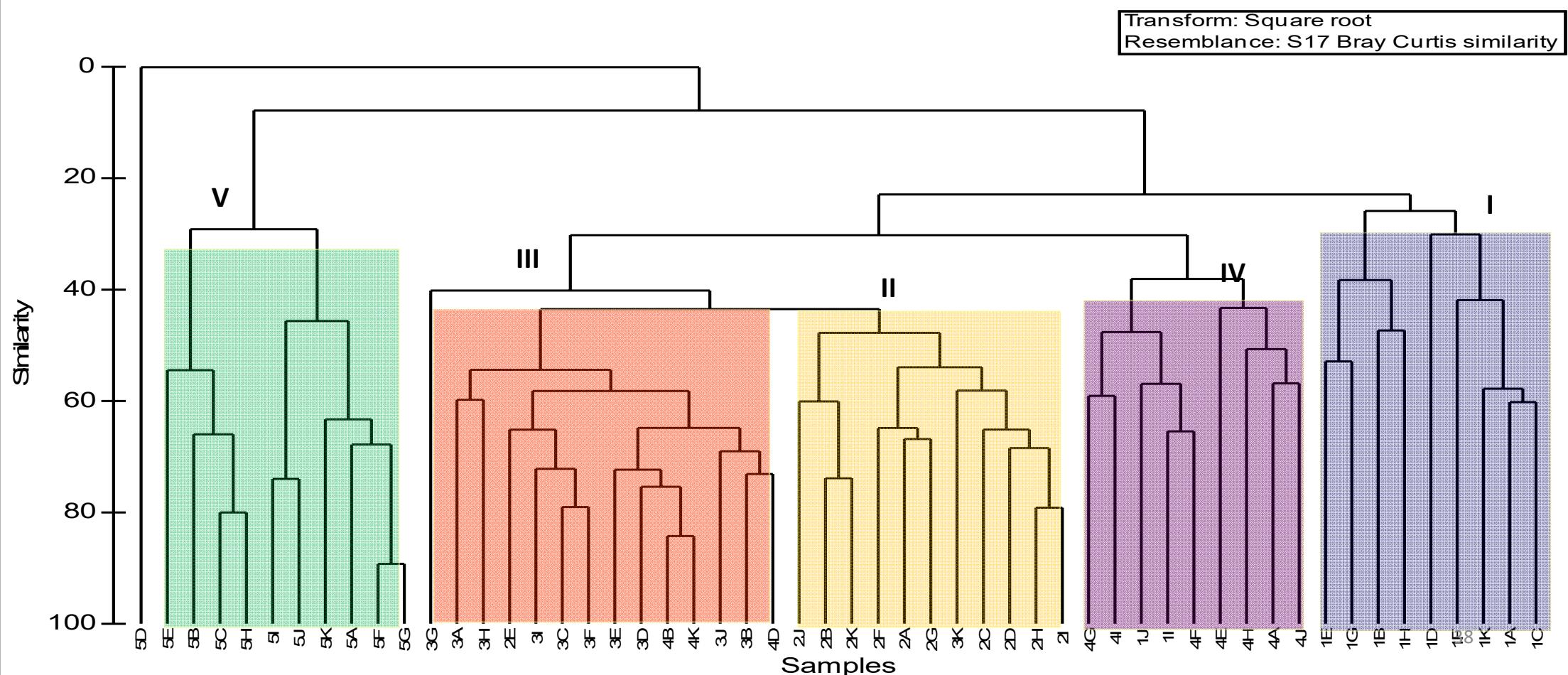
Benthic Macroinvertebrate community

- 7 order, 22 family, 37 genera, total 6280 individuals

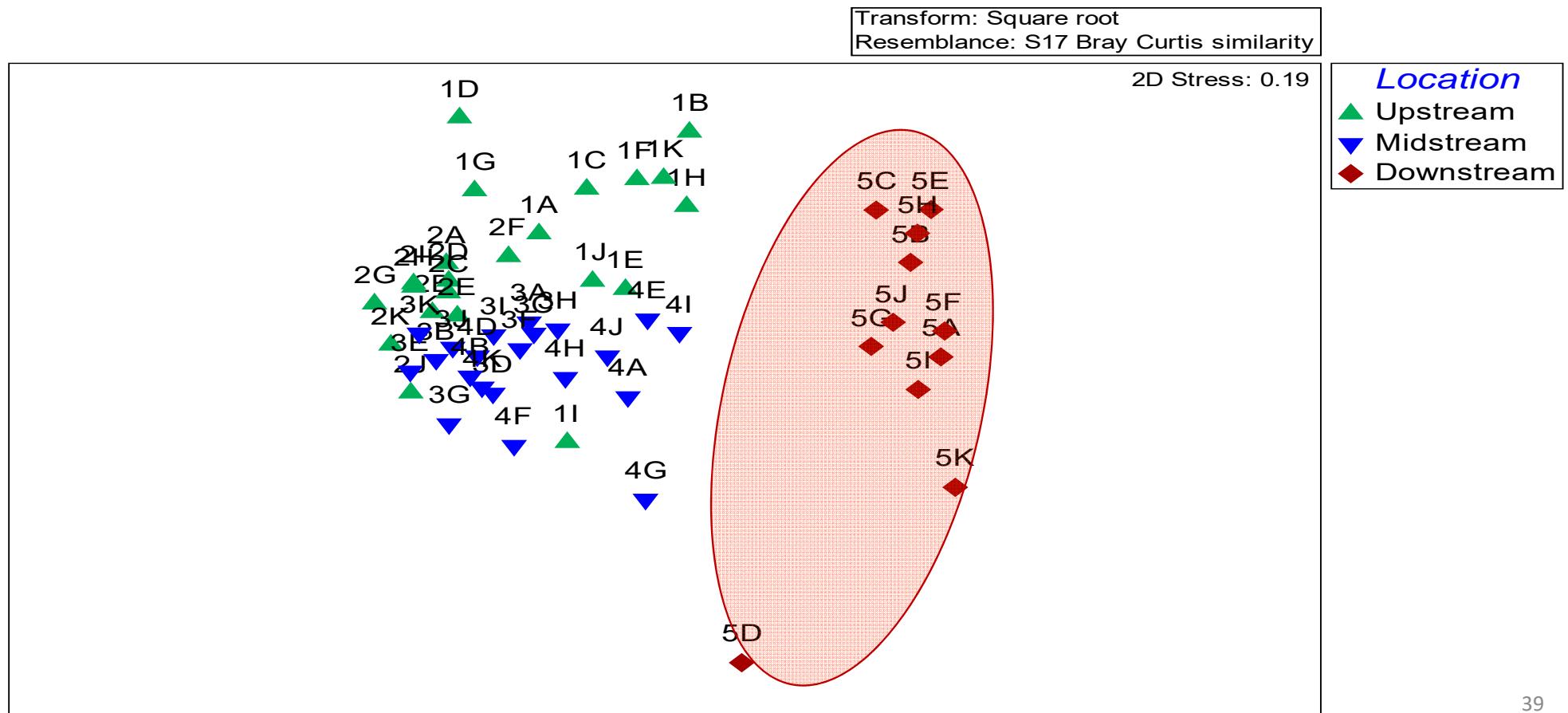
- Ephemeroptera
- Plecoptera
- Trichoptera
- Coleoptera
- Diptera
- Hemiptera
- Odonata



Benthic Macroinvertebrates community similarity

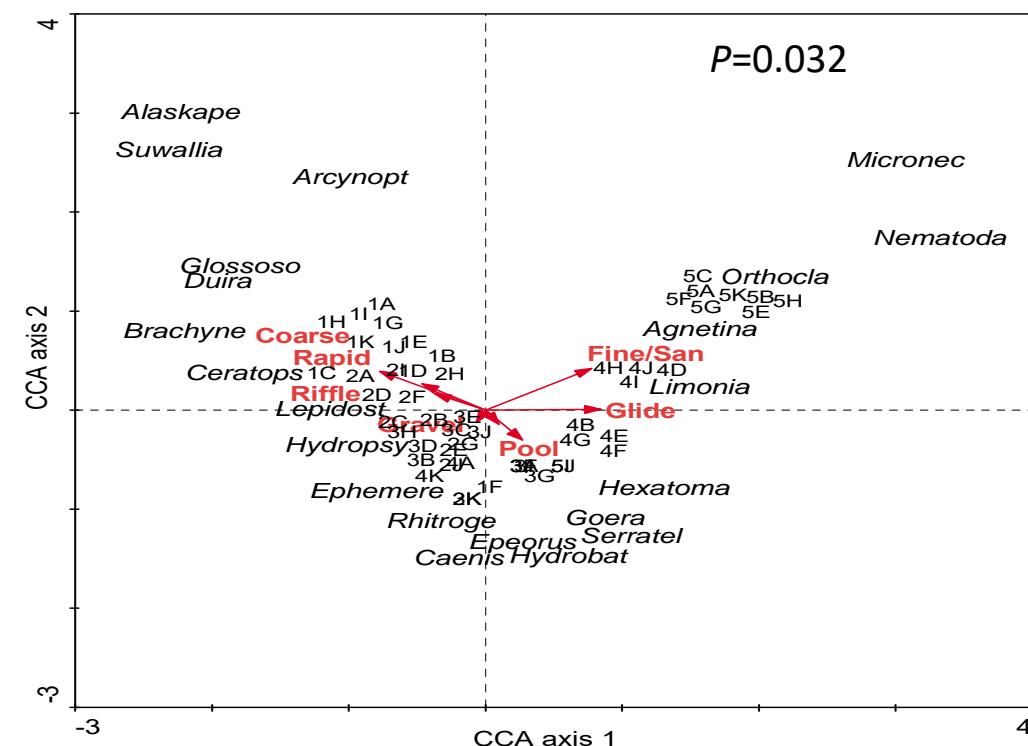


NON-METRIC MULTIDIMENSIONAL SCALING



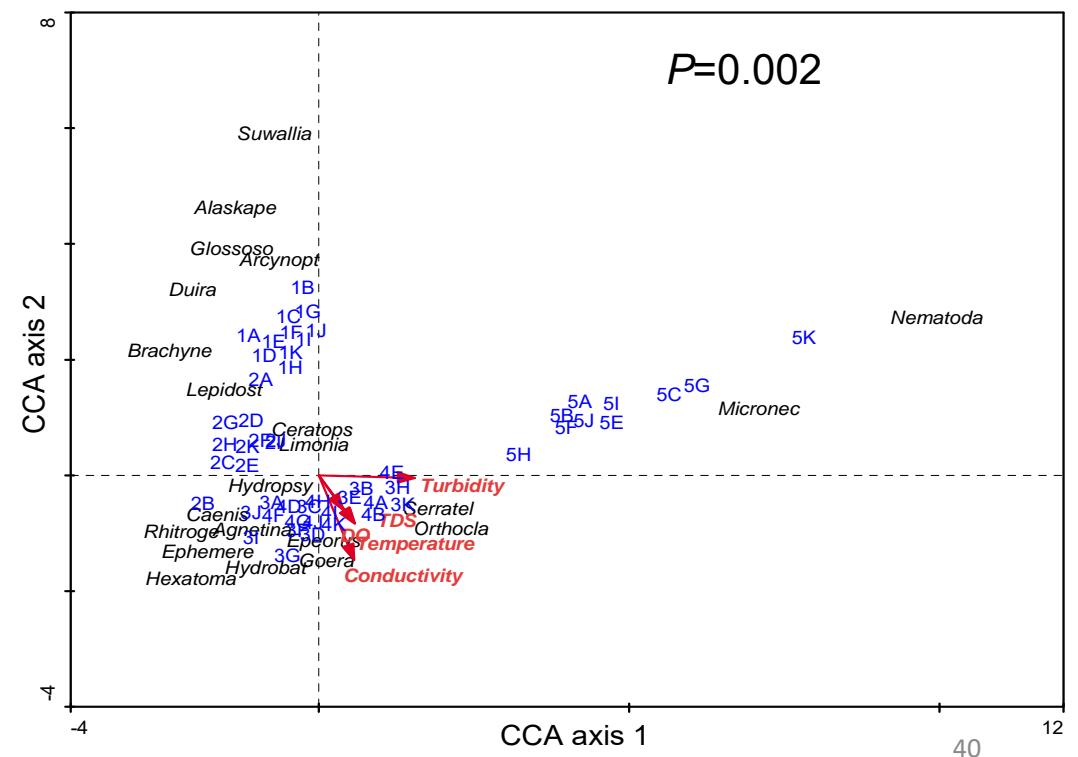
Correlation between macroinvertebrate community and physical habitat

Glide ($r = 0.60$) significant correlates with axis 1



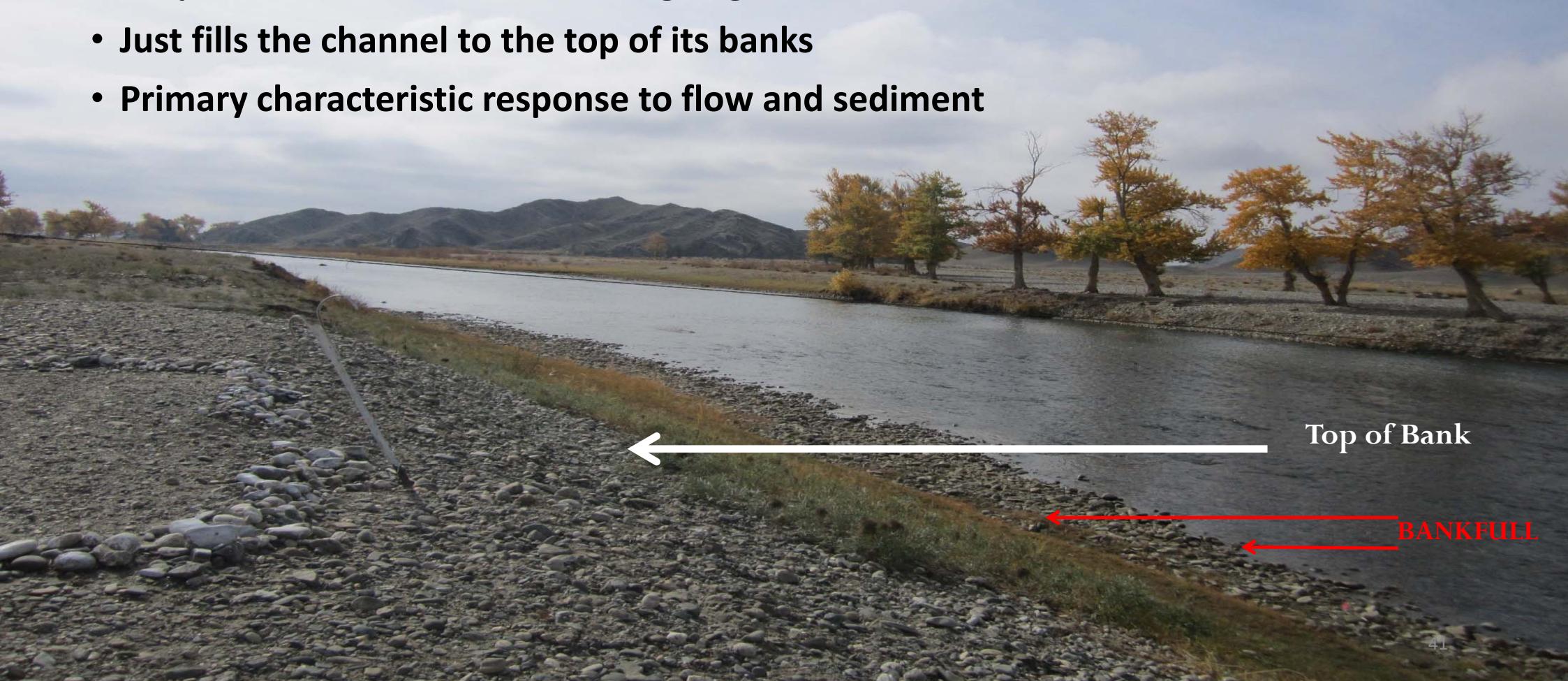
Turbidity ($r=0.74$) significant correlates with axis 1 that means downstream has more turbidity and

Nematoda, Serretela, Orthocladiinae, Micronecta

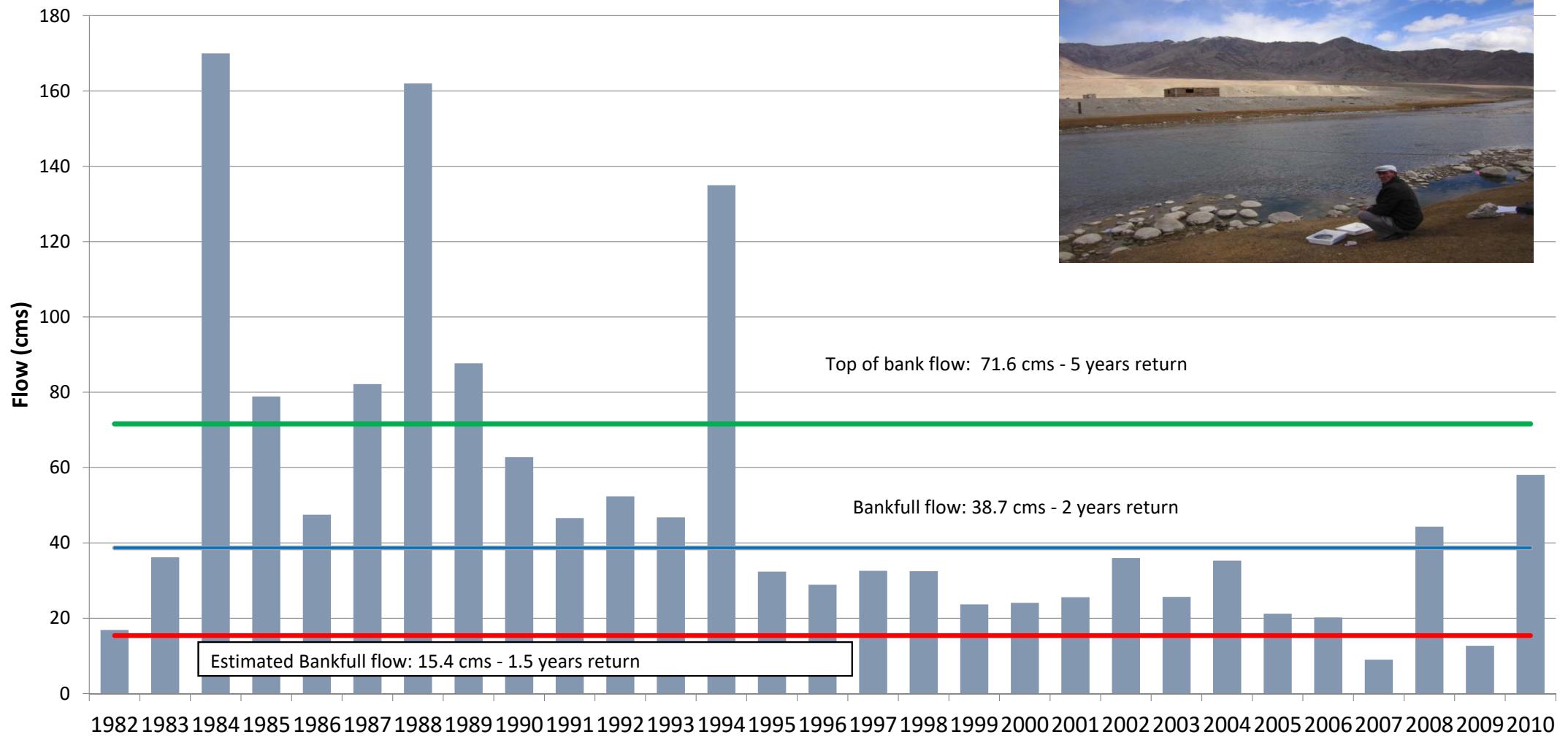


Bankfull Flow: Magnitude, Frequency and Duration

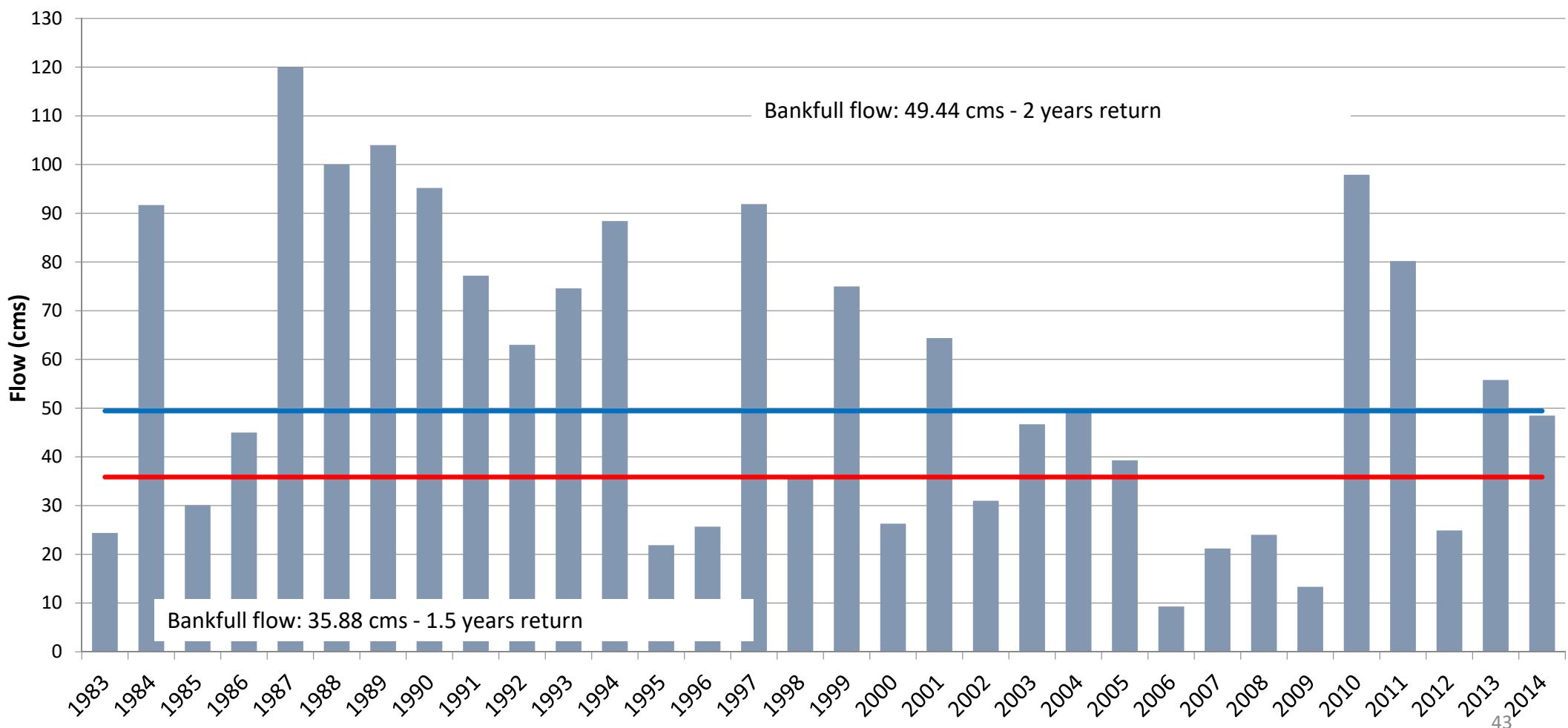
- Incipient elevation where flooding begins
- Just fills the channel to the top of its banks
- Primary characteristic response to flow and sediment

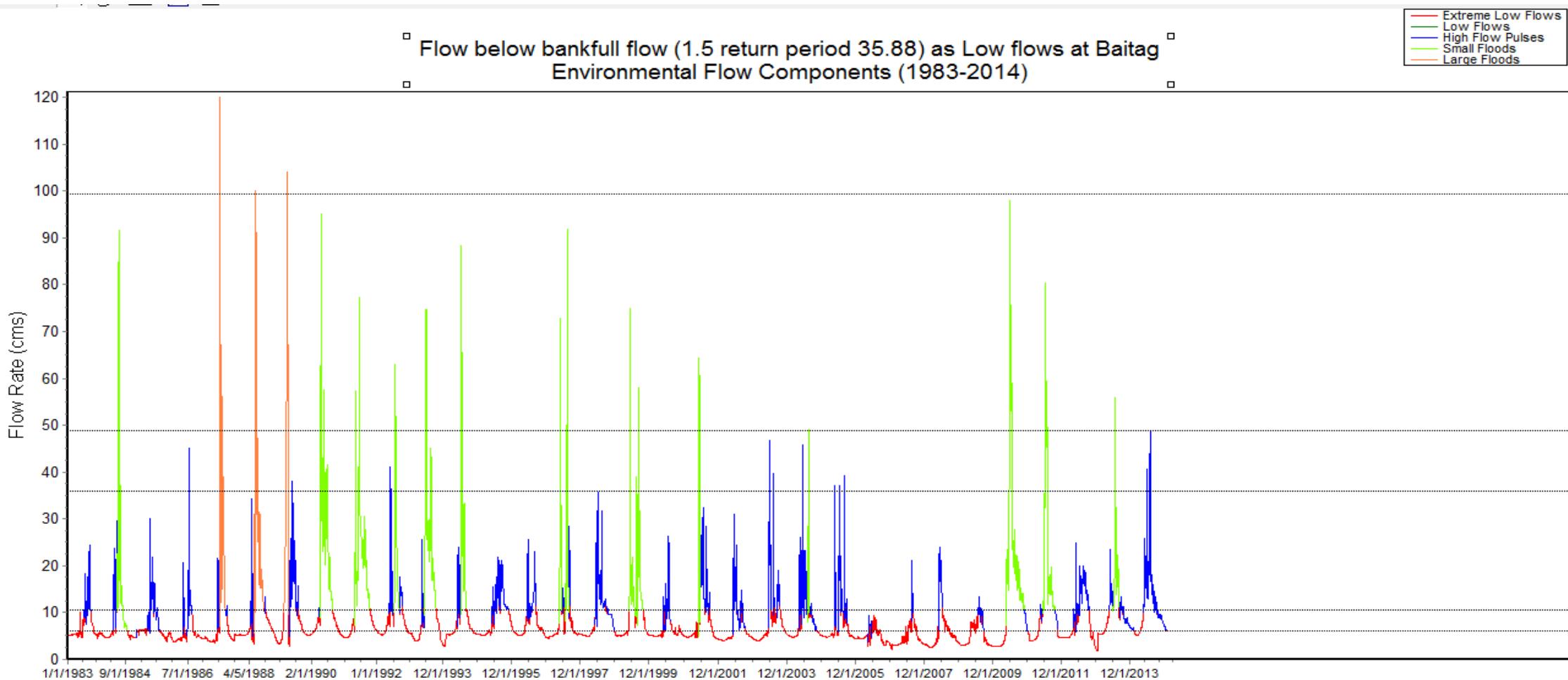


Annual maximums Bulgan River at upstream (1982-2010)



Annual maximums Bulgan River at downstream (1983-2014, Baitag)





Bankfull flow used as a minimum environmental flow (extreme low flow in graph) required macroinvertebrate and algae biodiversity richness of Bulgan River at Baitag downstream

Conclusion

- Bulgan River has natural flow regime according to physical habitat and biodiversity assessment of diatom and macroinvertebrate.
- Estimated bankfull flow – $35.88 \text{ m}^3/\text{s}$ (1.5 return) at Bulgan downstream accounting monthly and seasonal natural flow regime should be kept as an environmental flow to sustain habitat complexity and aquatic biodiversity life cycle.



camel – most useful animal in Gobi desert

- 3 breeds
- 600-700 kg weight
- 15-16 month milking period, 300 l/year
- 2.8-10.4 kg wool



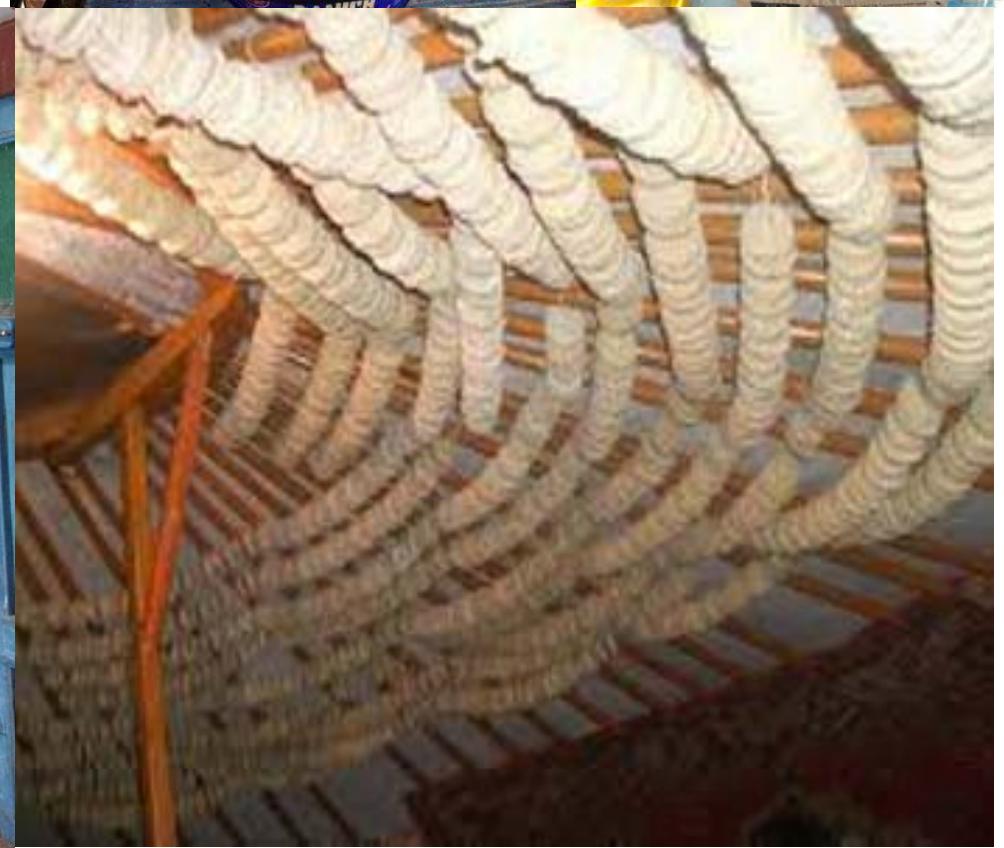


UNESCO Intangible cultural heritage-Coaxing ritual for camels





Summer Dairy product – winter reserve





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